THE WEEK'S EVENTS

LONG SECTION of upstream side of Fort Peck Dam slides into reservoir

Slide at Fort Peck Dam Moves Eight Million Yards of Fill

Long section of upstream face near east abutment slips into reservoir, burying eight men

A partial failure of the upstream face of Fort Peck Dam on Sept. 21 carried out some 8,000,000 cu. yd. of hydraulic fill, released waters from the 9,000-ft. core pool and buried eight men. Suddenly and without warning at 1:15 p. m. a section of the fill 2,000 ft. long at the top and at least 90 ft. deep slid upstream into the waters of the partly-filled reservoir, carrying 34 men, considerable plant and tons of riprap with it. All except eight of the 34 men escaped with minor injuries. As yet only one body has been found. The break extended far enough downstream to include the core and part of the downstream shell.

The cause of the failure has not yet been determined, though extensive investigations are being made by the Corps of Engineers, U. S. Army, builders of the dam. There is a possibility of a foundation failure in the Bearpaw Shale of the east abutment at the contact zone of the fill and shale bluff, or else a foundation failure in the river-fill material overlying the shale bed beneath the dam. Soil experts and other technical advisors of the Army Engineers are investigating the break.

Fill near completion

The dam, which has been under construction in the wide valley of the Missouri River in northeastern Montana since 1934, will contain 100,000,000 cu. yd. of earth fill placed by the full hydraulic method. Four 28-in. hydraulic dredges pump the material into place from distances as great as 27,000 ft. Hydraulic filling was to have been completed early this coming November following a record-breaking construction schedule. The main fill will be 9,000 ft. long at the crest, extended westward by a dike 11,500 ft. long completed in 1936. Ultimate top of dam is El. 2270; reservoir level will be El. 2250. The river bed was about

(*Continued on page* 389)

Construction Contract Let On Buffalo Housing

Construction contracts on the Lakeview housing project at Buffalo, N. Y., have been approved by USHA Administrator Straus. The contract for general construction is awarded to the John W. Cowper Co., of Buffalo on its bid of $1,780,000. The heating contract goes to Joseph W. Davis, also of Buffalo, for $248,000, and electrical equipment to the Ferguson Electrical Construction Co. of Buffalo for $156,000. Bids were also received on plumbing works for the project but have not yet been awarded.

The bids which were approved Sept. 24 did not include landscaping, mechanical refrigeration, or cooking and household service equipment which will be included in the apartment.

On the basis of figures now on hand, according to Administrator Straus, the cost per room in the Lakeview project will be less than $1,000, well under the statutory limits.

With construction scheduled to start Sept. 27, the Buffalo project was the second USHA job on which superstructures are rising. Financed by a 90 per cent loan of $3,643,000, the project includes 668 family dwelling units. It is expected to be completed within fifteen months.

Hurricane Swings Inland Devastating New England

Combination of tropical hurricane and major flood interrupts transportation and utility service, wrecks bridges and buildings and kills about five hundred people

A tropical hurricane moving northward on the regular hurricane path through the western Atlantic encountered an area of high pressure in the northern Atlantic Sept. 21 and was prevented from following the usual path out to sea. Instead, the storm center struck inland across New England and moved up through the Connecticut valley into Canada. It brought heavy rain and wind velocity approaching 100 miles an hour in some places to some of the most vulnerable and densely populated areas in the country.

A light, but steady, rain had been falling throughout the North Atlantic region for three days previously, and the storm precipitation created flood conditions in the Connecticut and Merrimac valleys. Neither of these rivers, however, reached the record stages attained in 1936. The Connecticut River at Hartford was 2.2 ft. below the 1936 peak and 2.9 below the 1936 figure at Springfield. The Merrimac River, likewise, below Lowell, was about 8 ft. lower than in 1936. Tributaries of both rivers, however, in a number of cases reached flows 35 to 50 per cent greater than two years ago.

This combination of serious flooding with unprecedented wind velocity caused property damage roughly estimated at about $200,000,000 and the loss of nearly 500 lives.

Contributing particularly to the loss of life in shore communities were unusually high tides and huge waves which devastated the summer communities along the low-lying outer beaches of Long Island. Thus at Oak Island Beach about half the houses were carried away; Westhampton Beach was swept nearly clean of buildings with great loss of life; and at Quogue the barrier beach is reported entirely gone.

Complete reports of damage done are still unavailable. Two *ENR* editors have been dispatched to the disaster zone, and detailed reports of the situation will be printed next week.

Railroads suffer badly

Damage to railroads was widespread and so serious that service has not yet been fully restored on the Shore Line of the New Haven and the Harlem division of the New York Central R. R. Though the damage was more extensive than in any previous storms no major structures were lost, the damage being limited to washed out fills, culverts and small bridges. Rail service to Boston, Providence, New London and many smaller cities was completely shut off for some days following the storm.

The New Haven and Long Island railroads were the worst sufferers, but the Harlem Division of the New York Central, the Boston & Maine, and Boston & Albany were all tied up during the period immediately following the storm. Long Island lines serving points on the south shore, especially at the east end of the island where the storm reached its greatest intensity, were washed out in many places.

The New Haven line up the Connecticut River was shut off by high water, but its Shore Line, which is carried across numerous shallow bays on fills or trestles for a considerable part of its length between New Haven and Providence, bore the brunt of the damage. Track was washed off fills and open-deck bridges or was badly undermined. The large number of these damaged sections, most of which could not be reached by repair crews until one approach track had been repaired, slowed up the repair work greatly. Service on the shore line was restored to New London by Monday but the section between New London and Westerly, R. I., about 19 miles, is still out of service and temporary bus service is being employed.

New York City and New Jersey were exposed only to the edges of the hurricane. They suffered considerable inconvenience but comparatively slight damage. In New York City, power was off for some hours in the Bronx; ferry service across the Hudson River was interrupted; and service in the Hudson Tubes was halted for some time due to flooding. Suburban railway traffic suffered serious delays.

There was no damage to bridges in the state highway system in New Jersey, according to the highway department, and damage to roads was of very minor nature, estimated to amount to not more than about $15,000.

Severe wave action washed out about 300 ft. of the Brigantine-Atlantic City bridge across Absecon Inlet, on the night of Sept. 21. A 230-ft. section, including a draw span, fell on the Atlantic City side, and a 70-ft. section on the Brigantine side also collapsed. A 200-ft. center section was left standing.

Although heavy loss of life occurred on Long Island, the damage, except to the Long Island R.R., was mostly to semi-permanent houses and other light structures. The 190-ft. steel tower of the Mackay radio station at Napeague Beach was blown over, on the afternoon of Sept. 21, halting trans-Atlantic radio service on the Postal System.

Connecticut cities suffer

Connecticut bore the brunt of the storm, and nearly every community in the lower Connecticut River valley suffered failure of transportation or light, and in many places the water supply was affected.

In New Haven, large sections of the city suffered the loss of telephone, light, and trolley service, mostly due to fallen trees. The meter house and pump room of the East Street sewage disposal plant was flooded, putting the plant out of service, and the Welton Street pumping station was likewise flooded. Motors of

Wide-World Photo

A SANDBAG DIKE was constructed along a half-mile of river front at Hartford to hold back the rising Connecticut. A force of more than 1,000 men built the levy in less than 24 hours

Wide-World Photo

THE CHICOPEE RIVER carried out this bridge near Chicopee Falls, Massachusetts

the Tomlinson Bridge were out of commission by submergence.

The Ferry St. bridge in New Haven suffered serious damage to the draw span pier when a large oil tank broke loose and floated against the bridge. The tank was lashed to the bridge in order to prevent it drifting down and damaging the Tomlinson bridge down stream. Motors of the Chapel Street draw bridge were also covered with water.

Hartford dikes hold

Flood damage at Hartford was substantially less than in 1936 because higher dikes have been built along the Connecticut. Only 13 per cent of the city was flooded as compared with the 25 per cent which was flooded in 1936. Moreover the Connecticut River rose only to 36.6 as compared with 38.5 in 1936. At the same time, the dikes, which were at at elevation of 35 in 1936, have been raised to 45 for half of their length and to 38.5 for the rest. One low spot about 4,000 ft. long which was still at elevation 32.5 was raised by a sandbag wall which was not overtopped.

The Morgan St. Bridge to East Hartford was closed. No utilities were out of service in Hartford.

Throughout Connecticut there was serious damage to bridges. At Lisbon-Norwich, a five-span concrete bridge, 225 ft. long, was damaged and may fall. A 66-ft. steel truss bridge over the Willimantic River at Willington was destroyed, and a 51-ft. girder bridge over the Hockanum River at Manchester was weakened. At Ashford a concrete bridge, 30 ft. long, over the Mount Hope River was destroyed, as was a 25 ft. brick arch bridge at Glastonbury. A large number of smaller bridges of all types were destroyed.

Damage to highways in the state is estimated by Highway Commissioner W. A. Cox, at about $1,000,000.

The Dyer Dam, 250 ft. wide, and 25 ft. high, burst near Danielson.

Bucks Dam at Stafford Springs, Conn., 40 miles from New Haven, failed on Sept. 21.

Several blocks along the water front in New London burned down due to the failure of water supply. The electric light system also failed there.

Water supply suffers

Both Massachusetts and Rhode Island suffered severely from failure of water supply systems. The water supply is gone at the city of Adams; all water supplied from springs is being boiled or chlorinated. The supply at Chicopee Falls has been curtailed through the failure of one reservoir. Water is being rationed at Orange, Mass.; the reservoir at Ware is submerged, and all water at East Brookfield is boiled and chlorinated, as is the case at Pittsfield and Dalton, Mass.

At Lowell, water is being supplied through an emergency pumping unit and chlorinated. Local Boards of Health in New Bedford and Fall River, Mass., have ordered all water boiled or chlorinated.

Damage to public property in Lowell, Mass., is given as follows by City Engineer Steven Kearney: buildings, $100,000; parks and playgrounds, $60,000; streets and sidewalks, $100,000; water system, $15,000; fire alarms and police system, $10,000.

At New Bedford, damage to city-owned utilities and structures was about $250,000 according to E. T. Hodson, Commissioner of Public Works.

At Fitchburg, Mass., on the Nashua River, the sewage system is reported disabled due to the breaking of mains. Five business blocks are reported burned in Peterboro, N. H.

Wide-World Photo

A BRIDGE at Bridgeport, Conn., was washed out on Sept. 21

A bridge was carried out at Weir, N. H., and a dam is reported to have burst at North Brookfield, Mass. A mill building at West Sterling, Mass., collapsed when its foundations were undermined.

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New York Abandons Plans To Dump in Jamaica Bay

Plans announced some weeks ago by the New York City department of sanitation to dump refuse in Jamaica Bay on Long Island have been postponed indefinitely because of opposition from residents of that section, Commissioner of Sanitation William F. Carey has announced.

Hearings Concluded On Buchanan Dam

State body tells investigators Colorado River authority was negligent

The investigating committee set up last July by the Texas Senate to determine whether improper operation of the Buchanan Dam of the Lower Colorado River Authority had contributed to the July flood on the Colorado River of Texas, has concluded its hearings. It will be some time, it was stated, before the committee completes its report and signs it. The report will be filed with the State Senate when the legislature convenes in regular session next January.

The committee's report, it is understood, will include conclusions and possible recommendations in regard to the power policies of the Lower Colorado River Authority. Senator Albert Stone, a member of the committee, said that the state must formulate a policy on the use of projects as between flood control and power generation.

In addition to voluminous testimony, the proceedings of the committee include reports by the State Board of Water Engineers, the State Reclamation Engineers, the U. S. Bureau of Reclamation, and the Board of Army Engineers.

In its report to the investigating commission, the State Board of Water Engineers said that information and data were available which would have justified opening the Buchanan Dam gates 24 hours earlier than they were opened. The board said that the Lower Colorado River Authority was negligent in not providing rainfall and stream gages before completion of the dam. Operation of the gates at Buchanan Dam, the board held, should have been such as to avoid releasing floodwater during the flood peaks on the Llano River, July 23-24; information with which to do this was available, the board held.

An investigator appointed by PWA Administrator Ickes stated in a preliminary report last August (*ENR*, August 18, 1938, p. 187) that operation of the dam had reduced the flood at Austin by 1 ft.

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Levee Plan Proposed For Lower Colorado

Working with funds of the Lower Colorado River Authority, the U. S. Bureau of Reclamation has completed a survey for a proposed system of levees along the lower course of the Colorado River. The report suggests three alternate plans for a levee system from Columbus to the Gulf.

One plan, which would provide levees with a carrying capacity of 150,000 sec.-ft. is recommended by the bureau as adequate if the height of the Marshall Ford Dam, now under construction by the authority, is raised.

If the present plans for the dam are not extended, the bureau recommends that one of the other two plans be used. One of these would provide levees carrying 200,000 sec.-ft. and the other carrying 250,000 sec.-ft.

The cost of the smaller program is estimated at $2,863,000. Costs of the other two are $3,977,000 and $5,238,000.

Rail Steel Prices Drop In Fourth Quarter

Steel price reductions have been announced on heavy rails and track supplies for the fourth quarter by the Carnegie-Illinois Steel Corporation. Rails were reduced from $42.00 to $40.00 per ton; tie plates from $46.00 to $43.00; track bolts from $87.00 to $83.00; angle bars from $56.00 to $54.00; cut spikes from $63.00 to $60.00; and screw spikes from $96.00 to $91.00 per ton.

Other major steel product prices have been re-affirmed for the fourth quarter.

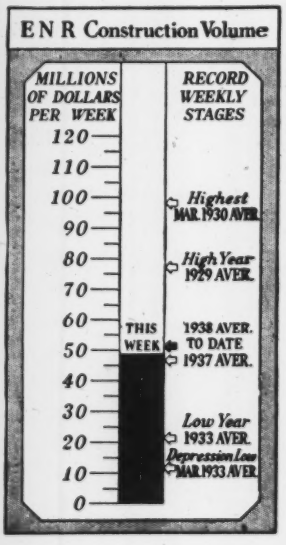
CONTRACTS AND CAPITAL

ENGINEERING construction awards for the week total $49,229,000, a 16 per cent increase over the corresponding week in 1937, but a drop of 40 per cent from the record volume of last week. This is the eleventh consecutive week in which 1938 values have exceeded 1937.

Cumulative construction awards for 1938 to date, $2,004,260,000, are 6.3 per cent above the $1,886,008,000 volume for the 39-week period last year.

Public construction is 74 per cent higher than a year ago, but 44 per cent lower than the high volume of a week ago. Private awards are 53 and 14 per cent lower, respectively, than last year and last week.

Waterworks, sewerage, public buildings, earthwork and drainage, streets and roads, and unclassified construction all report gains over their 1937 totals, and are responsible for the public construction gain over last year.



Sewerage and bridges are the only groups to gain over the record preceding week.

New capital for construction purposes for the week, $52,388,000, is 114 per cent above last year, and brings the total for 1938 to date to $3,112,868,000, 54.5 per cent higher than the volume for the 39-week period a year ago.

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CONTRACTS

(Thousands of dollars)

	Week Ending Sept. 30 1937	Sept. 22 1938	Sept. 29 1938
Federal	$7,591	$7,451	$4,297
State & Municipal	15,461	64,237	35,811
Total public	$23,052	$71,688	$40,108
Total private	19,442	10,564	9,121
TOTALS	$42,494	$82,252	$49,229

Cumulative	
1938 .... (39 weeks)	$2,004,260
1937 .... (39 weeks)	$1,886,008

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	1937 39 Wk.	Cumulative 1938 39 Wk.
NON-FEDERAL	$1,268,682	$1,973,750
Corporate securities	455,947	332,077
State & Mun. bonds	404,670	441,094
PWA loans, grants	178,126	672,286
RFC loans	29,939	97,391
U.S.H.A. loans	.....	202,807
R.E.A. loans	..	46,595
Federal Aid-highways	200,000	201,500
FEDERAL	746,223	1,139,118
TOTAL CAPITAL	$2,014,905	$3,112,868

FHA MORTGAGES

	1937 38 Wk.	Cumulative 1938 38 Wk.
Mortg. selected for appraisal	$474,960	$741,423

ENR INDEX NUMBERS

Index Base		1913	1926
Construction Cost	Sept.	232.70	111.86
Building Cost	Sept.	194.80	105.30
Volume	Aug.	218	96

Construction Men To Meet on Coast

Road builders and general contractors to hold joint meeting and equipment show

A joint meeting that promises to be the largest gathering of construction men and the most extensive display of construction equipment ever held on the Pacific Coast has just been authorized by the executive boards of the American Road Builders Association and the Associated General Contractors of America. The joint meeting and equipment show is to be held in San Francisco, March 5-11, at which time the Golden Gate International Exposition will be open. Convention sessions of the two organizations are to be arranged to permit ample opportunity for those in attendance to see the splendid exhibit of latest construction equipment.

This is the first time since 1933 that the two organizations have held concurrent annual meetings. In that year, twenty national organizations in the construction field held a Highway and Building Congress in Detroit. Despite unfavorable business conditions, 121 manufacturers displayed equipment at that joint meeting.

Asphalt Institute meeting

Another Pacific Coast attraction for highway builders will be the annual meeting of the Asphalt Institute which is to be held in Los Angeles Feb. 27-March 3 one week ahead of the San Francisco meeting.

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Concrete Pavement Yardage Rises in August

Concrete pavement yardage awards for August, 1938, are 25 per cent above last August as reported by the Portland Cement Association. Road yardage is 8 per cent higher; street yardage, 73 per cent higher, and alley yardage, 69 per cent higher.

Awards for 8 months of 1938 are 3 per cent below the corresponding period last year. Road and alley yardages are 11 and 39 per cent higher, respectively, than a year ago, but road yardage is 7 per cent lower.

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Spheroidal Oil Tank Explodes in Test

A new spheroidal oil storage tank exploded under test Sept. 21, at the Sarnia, Ontario Works of Imperial Oil Co., Ltd. One man working on the top part of the tank was killed instantly.

The tank, which was being tested hydrostatically, had a capacity of 80,000 bbl. An oil company statement said that there was no gasoline in the tank at the time of the explosion.

The tank had been built by Horton Steel Works, Ltd., of Fort Erie, Ontario. It had not yet been officially turned over to the owner.

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Chicago Subway Plans Modified by Experts

A board of PWA consultants appointed by Secretary Ickes to review Chicago subway plans submitted in connection with an application for a 45 per cent grant on a $32,000,000 subway project to form part of a comprehensive rapid transit system for the city (*ENR* Oct. 28, 1937, p. 694) in a report just published proposes major changes in the West Side terminals of the city's plan, extensions of the State St. mileage and construction of the subway in tunnels rather than in open cut. Two proposals were made by the consultants, first, a project kept down to the original $32,000,000 application, and second, an extended program to cost $37,910,000. The board checked the city's estimate of costs. Details of the proposed work will be given next week.

The PWA consulting board is headed by H. M. Waite, former deputy administrator, PWA. Other members are Robert Ridgway and H. M. Brinckerhoff, consulting engineer, New York City, and Joshua D'Esposito, PWA resident projects engineer, Sanitary District of Chicago. Philip Harrington, traction engineer for the city of Chicago, and Charles E. DeLeuw, consulting engineer, prepared the PWA application plans.

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Fraud on Electrical Work Charged in New York

Nine New York City electrical contractors, all members of the New York Electrical Contractors Association, were indicted Sept. 22 on charges of conspiracy to prevent free competition on bids on electrical work for city and private jobs.

The indictment charges that collusive bids were systematically submitted on electrical work on large jobs in the city and that the defendants coerced and bribed other persons and corporations in connection with these bids.

It is understood that city jobs involved in the alleged conspiracy include the Ward's Island sewage disposal plant, the Lincoln Tunnel, and the Independent Subway.

Fort Peck Dam Slide

(*Continued from page 385*)

El. 2000 at the channel. At the time of the break the top of fill was El. 2240. On the upstream face the slopes of the fill vary from 3:1 to 5:1; downstream the slope is 8½:1.

During construction the river is being diverted through four tunnels 24 ft. 8 in. diameter, driven through the shale under the east abutment. As the purpose of the project is to regulate the flow of the Missouri, considerable water was stored behind the partly-completed dam last spring to permit some regulation this year. At present the reservoir level is El. 2117, about 20 ft. below the maximum level last July 22. The break did not disturb the center of the fill below reservoir level, though the extent of disturbance on the upstream face below water level is not known because of the covering of debris and the washing of the core pool water.

Tunnels not blocked

The slide did not affect the tunnels, and they are operating in normal manner. Fortunately, the toe of the slide veered away from the tunnel inlets, otherwise they might have been blocked.

Prior to completion of the tunnels in 1937 the dam was built in two sections, one on either side of the river channel. The east section, 4,500 ft. long, was about twice the length of the west section. The slide extended only half way from the east abutment to the center closure section of the dam, thus this rapidly-filled center part was not affected.

Late last fall a supporting berm was pumped into the old river channel upstream from the dam, extending from a contact with the fill at El. 2112 for 1,500 ft. upstream on a flat slope. This berm is some 4,000 ft. long; its eastern edge is close to the western end of the break.

Some equipment lost

Placing of heavy riprap on the upstream face had been completed to El. 2162. Tons of this heavy quarry stone, obtained at Snake Butte 160 miles away, were carried away by the slide. Equipment lost includes a core pool pump barge, two draglines, four tractor cranes, five tractors and two trucks.

Pumping of the fill has been resumed on the western end of the dam by two of the four dredge units. Plans for replacement of the lost fill are now being made under the direction of Major Clark Kittrell, district engineer in charge of the project. The accident will postpone completion of the fill until next year, for cold weather usually shuts the job down late in November.

J. H. MacDonald Dies A.R.B.A. Founder

Stewart, Canadian railroad builder, and Hartman of Baltimore firm among week's deaths

James H. MacDonald, first highway commissioner of Connecticut, a founder of the American Road Builders Association, for fourteen years president of that organization, and since 1918 its treasurer, died in New Haven, Sept. 22, at the age of 87.

MacDonald was a member of the original three-man highway commission created in Connecticut in 1895. Two years later the highway department was reorganized and MacDonald was made one-man commissioner, continuing in that post until 1913. Active in the founding of the American Road Builders Association, MacDonald headed that organization as president for fourteen years. Since 1918, he has been treasurer of the organization.

J. W. STEWART, Canadian railroad builder and contractor, died in Vancouver Sept. 24, at the age of 76. Stewart arrived in Canada in 1882 from Scotland and became active in the building of the Grand Pacific, the Canadian Northern, the Canadian Pacific, and the Pacific Great Eastern. In the 90's he was an engineer and later a partner with Foley Bros., Larsen & Co., building railways in Montana. During the World War, Stewart had command overseas of Canadian railway troops with the rank of colonel, later rising to the rank of major general. After the war he was active in the firm of Stewart & McDonnell.

ALFRED H. HARTMAN, vice-president of the Consolidated Engineering Co. of Baltimore, died Sept. 24 while visiting Oakland, Calif., at the age of 59. Hartman graduated in civil engineering from Delaware College in 1900 and received a C.E. degree at that institution in 1905. After working for several railroad companies he joined the sewerage commission of the city of Baltimore in 1906 as assistant engineer, and later as division engineer. He practiced as a consultant in Baltimore for a number of years and during the war joined Consolidated.

CECIL M. TAYLOR, civil engineer for the Appalachian Electric Power Co. of Bluefield, W. Va., died there recently at the age of 38.

WILLIAM B. SPENCER, civil engineer, active for the past two years on construction projects in Central America, died in Montclair, N. J., Sept. 25, at the age of 61. Spencer was associated for many years with his uncle, the late John Bogart of New York City.

EDMUND B. NAGLE, said to have been the oldest practicing surveyor in Canada, died Sept. 20 in Ottawa at the age of 81.

JOHN M. MILLER, a retired construction engineer of New York City and St. Petersburg, died in Wallace, Idaho, Sept. 22 at the age of 51.

BIRNEY C. MOELLER, 49, a civil engineer on the Tri-County Hydro-electric project in Nebraska, died in Lincoln, Sept. 20.

MOSES P. LIDDEL, 83-year-old contractor of Atlanta, died there Sept. 20. Liddel had been connected with the Camp Construction Co., the Van Winkle Co., and the Murray Co.

SINGLETON KING, 71, for many years city engineer of Youngstown, Ohio, died Sept. 16 in Kent, Ohio.

THOMAS J. FOLEY, Evanston, Ill., paving contractor, died there Sept. 19 at the age of 59.

CHARLES H. MOORE, 62, for the past fourteen years district engineer for the North Carolina highway department, died in Rutherfordtown, N. C., Sept. 20.

EUGENE J. SPENCER, consulting electrical engineer of St. Louis, who had served with the U. S. Engineer Corps on inland waterway work from 1885 to 1888, died in St. Louis Sept. 22, at the age of 79. Spencer served during the Spanish American War in the Third United States Volunteer Engineers with the rank of lieutenant colonel of engineers. During the World War he served as an engineer officer in this country and overseas with the 36th and 32nd Engineers, rising to rank of brigadier general by the end of the war.

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Flood Control Engineer At Los Angeles Resigns

C. H. Howell, chief engineer since 1935 of the Los Angeles County Flood Control District, resigned from the district on Sept. 20, effective Oct. 21.

Howell will return to the U. S. Bureau of Reclamation to direct the Colorado-Big Thompson water diversion project. He was with the bureau before he became chief engineer of the flood control district.

During Howell's service with the flood control district he completed San Gabriel Canyon Dams Nos. 1 and 2, twelve debris basins, and miles of concrete channel protection in the foothill areas damaged in the 1934 flood.

LABOR NOTES

A STRIKE of city-employed hoisting engineers at St. Louis, which had lasted about two months, ended Sept. 20 without the men having gained their objective. The hoisting engineers struck July 5 seeking increases from $1.50 and $1.75 to $1.75 and $2.00 an hour.

Union building workmen on city projects terminated Sept. 1 a strike called mainly in sympathy with the hoisting engineers (*ENR* September 8, 1938, p. 285). During the strike, the city maintained that the hoisting engineers had failed to establish that the increases asked would correspond to the prevailing union rates. It was contended also that the demand should have been made before the beginning of the city's fiscal year in April.

THE OKLAHOMA WPA administration has been placed on the unfair list of the Oklahoma Building and Construction Trades Council, the council charging that unskilled men are being employed as skilled building workers on WPA construction in Oklahoma. WPA asserts that this is necessitated by the requirement that 95 per cent of the project employees be relief workers.

AN INJUNCTION and $60,000 damages are sought against the Springfield, Ill., locals of the operating engineers and the hod carriers and common laborers unions in a suit brought by the Mississippi Lime Co. The company, which says it operates open shop, charges that the unions have boycotted its product.

A PROPOSED ORDINANCE in Jacksonville, Fla., would require contractors on city projects to give preference to local labor. Outside workmen could only be called in with the permission of the city council.

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Stiffer Compensation Law Passed in Pennsylvania

The Pennsylvania State legislature has passed and sent to the governor an amendment to the workmen's compensation act which would impose a presumption of negligence on employers in court actions seeking damages for injury or death to an employee.

The injured employee would be entitled to double damages if a jury found that the accident was caused through the employer's violation of or failure to observe any safety law or regulation. (*ENR*, Aug. 18, 1938, p. 118.)

News continued on adv. page 18

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Construction Visitors

Sir: Referring to the editorial, "Construction Works on Show" (*ENR* Sept. 8, 1938), it has been a continual source of amazement to me that Boulder Dam is able to attract an average of more than one thousand visitors a day. There was a time when we believed that the number of visitors going to Boulder Dam was greater during the construction than it would be at any time afterward. However, this has not proved true. The number has risen continually and now is almost twice as large as when Boulder Dam was under construction. Grand Coulee Dam likewise is a major attraction. We have every reason to believe that Shasta Dam will be a rival of Grand Coulee and Boulder in this regard. The smaller and less spectacular structures also are visited by many, though even the sum of their visitors does not equal that for Boulder Dam.

Especially in connection with dams built by the government, I believe, in the future, we all will find the public demonstrating a greater and greater interest. This can not but be a healthful development. It will tend to provide a more informed public opinion concerning these works, and, as you note, it will give a wider understanding of the service of the engineers and constructors to the community.

W. E. WARNE
U. S. Bureau of Reclamation
Washington, D. C.

Land Fill: Pro and Con

The following comments refer to the article, Land Fills for Refuse Disposal, by E. J. Cleary, which appeared in the Sept. 1 issue, p. 270.—EDITOR

Sir: After carefully reading the article on refuse land fills in New York I cannot refrain from placing on record a few pertinent facts to prick the bubble before it has further chance to expand and thereby cause universal misunderstanding. It so happens that I was and still am vitally concerned with the garbage dumps in Queens County, and consequently have intimate knowledge of conditions.

It is unfortunate that the article conveys, perhaps unintentionally, the inference that sanitary fill, controlled tipping or whatever it may be called, is a new and a very cheap method of disposal which might be utilized to displace incineration.

Briefly, the method is as old as the earth itself. Even thus, very few progressive communities have seen fit to adopt it, except perhaps as a temporary expedient. San Francisco is probably the only city of any size in this country, excluding of course, the present practices now under criticism in New York, that has resorted to it on a large scale. That city has seriously considered incineration as a solution for the last 5 years or so to eliminate the present nuisance.

Evidence of the fact that the method is far from acceptable to persons living within the radius of several miles of the dumps can be found in the numerous articles of criticism which have appeared in local newspapers since Commissioner Carey's dream was put to actual practice. Mr. Joseph Zengerle, who serves as Chief Engineer in Mr. Carey's own department, termed the method a "fantastic layman's idea" in a recent published paper (*American City* magazine, Nov. 1937, p. 17). Park Commissioner Moses who, all will agree, is qualified for a statement, also seems to have serious doubts as to its value.

In New York City it can not be a case of insufficient incinerator capacity as 11 incinerating plants have been shut down in favor of this so-called "modernized version of refuse disposal." Cheapness of the method is stressed by Mr. Cleary, but has he any knowledge of the increased collection costs brought on by longer haulage distances? Even though it may be a cheaper method, that does not necessarily mean that it is acceptable, any more so than if we were to revert to the old privy which is concededly cheaper than our modern bathrooms.

Now for a few facts pertaining to the particular problem at hand. Last month the District Attorney's office in Queens County undertook an investigation of the conditions at Mr. Carey's "scientific" dumps, as a result of the demands for relief by taxpayers in the vicinity. The Ekroth Laboratories, Inc., were retained to conduct bacterial and chemical analysis of the liquid run-off and its effect on nearby waters.

A copy of the results with interpretations and opinions is enclosed, but as space will probably not permit its publication in full, I shall touch upon a few of the vital points. In all samples but one, heavy coli-aerogenes counts were found. Regarding the negative sample, it was reported that the presence of 56 p.p.m. of copper and 448 p.p.m. of iron undoubtedly would inhibit, if not entirely prevent, organisms of the coli-aerogenes group, if they had been present in the first place. In the same sample, the organic content was extremely high. Incidentally, the negative sample in question was taken immediately adjacent to the Jameco pumping station which supplies potable water.

In the other samples, total bacteria counts per c. c., 24 hr. plate count, varied from a minimum of 1,600 to a maximum of 520,000 and the count on the most probable number of organisms of the coli-aerogenes group per 100 c. c. showed a minimum of 170 to 18,000, in seven other samples.

The matter is now in the courts and a permanent injunction is sought by the taxpayers. Already two dumps have been discontinued by Carey, and the discontinuance of the balance may be forced soon. As a matter of interest, it might be pointed out that the level area of land so neatly pictured in your article has settled irregularly in depths of up to 4 ft.

EDWARD T. RUSSELL
Chairman, Sanitation and Water Committees
Community Councils of
the City of New York, Inc.

Sir: I can state that the fill and cover method of refuse disposal has proven much more satisfactory in San Francisco than incineration, both from a standpoint of economy and development of heretofore worthless tide lands. (See *ENR*, Feb. 27, 1936, p. 314).

It may be of interest to provide a brief comparison of the controlling factors of the San Francisco fill and cover method with practice in New York City as described in your article:

1. San Francisco refuse is conveyed in railroad gondola cars: the New

(*Continued on adv. p. 22*)

ENGINEERING NEWS-RECORD

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Editorial Offices at 330 West 42nd Street, New York

SEPTEMBER 29, 1938

ONE LESSON emerges prominently from the tragic news of the New England and Long Island hurricane devastation: neither exposed beaches and sandspits nor flood channels of rivers should be used for dwelling purposes. In respect to flood channels this is not a new teaching, though the people of New England river towns who lived through the unprecedented flood of two years ago can now appreciate its force even better. Similar restriction of living on exposed beaches is a less familiar thought, yet the hurricane effects prove that dwellers in such locations must look forward to being sometime engulfed and swept away by an exceptional storm. The conclusion is inescapable that both kinds of danger spots are unfit for human habitation and should be branded as such by official declaration in the interests of the secure existence of the community. It would be most effective if dangerous beaches as well as river flood areas were zoned against unsafe use. But if this should be considered too extreme an infringement of individual freedom, then at least their hazardous character should be declared by competent authority and entered in the public land records as permanent warning to all who might be tempted to settle and build on them.

The River Floods

OUTDONE BY WIND AND OCEAN in property destruction and deaths, the New England river floods are nevertheless a phenomenon of major importance. Coming only 30 months after the alltime high water of 1936, last week's floods in the Connecticut and Merrimack all but equalled their record stages; numerous tributaries indeed exceeded all previous records. The flood disaster emphasizes again the danger of complacency in probability calculations that place such floods at 100 to 500 years intervals. Most important, they bring home the seriousness of the stalemate that was allowed to develop over flood control plans in New England, when Congress refused to ratify the state compacts because states would not cede their rights to control of power sites in return for federal flood-control money. While the compacts were concerned mainly with reservoir construction, the abandonment nevertheless delayed local flood protection work at several vital points. New England cities were not as ready to cope with high water as they should have been. The important lesson is that New England, subjected to two destructive floods in less than three years, deserves immediate reconsideration of its flood-control plans by the federal government.

Winter Checkmated

WINTER IS RAPIDLY LOSING its threat to concrete work in heavy construction. In building it ceased to be a particular hazard years ago, for quick-hardening concretes and improved means for heating and housing eliminated the major technical reasons for seasonal construction; only long habit remains a deterrent to a twelve-month building year. In heavy construction the controlling obstacle to cold-weather work has been loss of heat in the haul from the mixing plant to the forms. Mass delivery in large containers solved the problem where this method was practicable, but in continuous delivery by chutes and pipes the solution was not so easy. Insulation to retain mixer temperature during the long, slow delivery of thin streams of concrete is cumbersome if it is to be really effective. It is this that gives special interest to the pipe-line transportation of concrete on a northern Maine dam, as described in this issue. Two conditions favored the method used: The travel distance was not great, and the stream of concrete was compact and of substantial volume. With longer pump lines the added protection of pipe insulation would probably assure an equally successful result.

Failure at Fort Peck

ALMOST LIKE SHIPWRECK in sight of land, the earth slip at Fort Peck only a few weeks before completion of the huge embankment shatters well-founded hopes. Quite aside from the loss of life it involved, the accident belies the expectation that scientific soil control in embankment building would do away with the risk of slides and slips, notorious threat to hydraulic-fill dam construction heretofore. Careful control utilizing all the resources of modern soil-mechanics procedure was applied in the Fort Peck work, yet slip failure occurred just as in dams guided only by rough and ready judgment. The exceptional magnitude of the slip—a volume of 8,000,000 cu. yd. is reported to have moved—has little meaning, since it is proportionate to the size of the dam as a whole, but that a slip occurred at all is significant. It is important, therefore, that the causes of the failure be fully explored. The investigation should show whether foundation failure or embankment slump occurred, whether the topping out of the

dam was carried on too rapidly for adequate drainage of the core pool banks, whether unstable material became pocketed in the upstream bank, and whether the selection and grading of the material were such as to assure stability. The slip should be explained not only to advance the knowledge of safe dam building but to reestablish scientific soil control as a dependable guide in hydraulic fill work.

Hurricane Experience

THE HURRICANE that swept the Long Island and Southern New England shore regions on Sept. 21 set a new high mark of storm and flood violence and brought to light dangers to those regions not previously known or suspected. With a death roll well beyond 500 and a total of losses that may reach nine figures, it surpassed the worst gales known along the upper coast. Protective measures against such visitations of nature are at best of limited value; yet even while salvage and rehabilitation are going on it is necessary to give thought to possible safeguards against such abnormal experience.

Outstanding is the realization that past freedom from hurricane visitation gives no assurance that it may not come at some time. The destruction wrought is an impressive reminder of the fallibility of normal experience and the chance of error in forecasts and calculations based on such experience. While present information is still too fragmentary for conclusions, the havoc wrought gives clear proof of extreme wind forces, of intensified storm effects due to the impact of water borne along by the gusts, of abnormal tides and storm waves, and of unforeseen flood hazards.

This is clear, never again should coast communities along the North Atlantic seaboard assume that a tropical hurricane will follow the normal route and swing over the ocean. Hereafter, hurricane warnings to North Atlantic shipping should be a signal for forced evacuation of exposed shore regions.

Floods in New England's principal rivers that exceeded all but the exceptional 1936 record bring us face to face with the fact that the unprecedented disaster of two years ago is not as rare and improbable a contingency as has been thought up to now. It may be necessary to review all estimates and designs based on flood frequencies deduced from the 1936 flood, in the light of this new experience.

Wind forces far beyond the customary design figures are indicated by many of the hurricane effects. Design practice for structures along storm-exposed shores will doubtless require reconsideration to take account of the wind effects deducible from the hurricane wreckage. Forces calculated from wind velocities alone will probably not be sufficient, for spray masses may intensify the destructive pressure effects of the wind.

Above all, the devastation and erosion along the coast warn us that it is time to begin serious study of beach and shore actions and means of protecting the immense values of our waterfront. Up to now this important subject has had recognition from only two or three states, and with such limited cooperation the federal Beach Erosion Board has been able to accomplish only correspondingly limited results. If we are to make real headway against shore dangers we need in every seaboard state a competent agency to act both on its own account and in cooperation with the federal government to develop adequate knowledge of shore phenomena and protection.

A Field for Research

BOTH scientific and practical advance in knowledge of refuse disposal could be achieved through research on sanitary fills. In view of the success and economy of the land-fill method in New York as well as in San Francisco and Fresno, Calif., there is likelihood that other cities would find it profitable. But to insure the most efficient and intelligent application of the scheme a number of questions that bear on its use ought to be answered.

Information is needed first of all on the nature of decomposition taking place in a covered mass of mixed refuse. What classes of organisms are active, how is this action affected by water, and what, if anything, can be done to speed up reactions? What are the gaseous and liquid products of the decomposition, and what is their effect on the air above the mass, the surrounding soil and the groundwater? These questions demand both scientific and practical answer.

The settlement and compaction resulting from the decomposition likewise call for investigation. The effect of initial compaction should be determined, and the factors that influence the settlement of the fill and its load-bearing capacity need to be fully explored. This phase of the research logically would include also study of the best depth of fill, its relation to cover depth, and the effect of the fill material on piles, foundations and pipes which may later be buried in it.

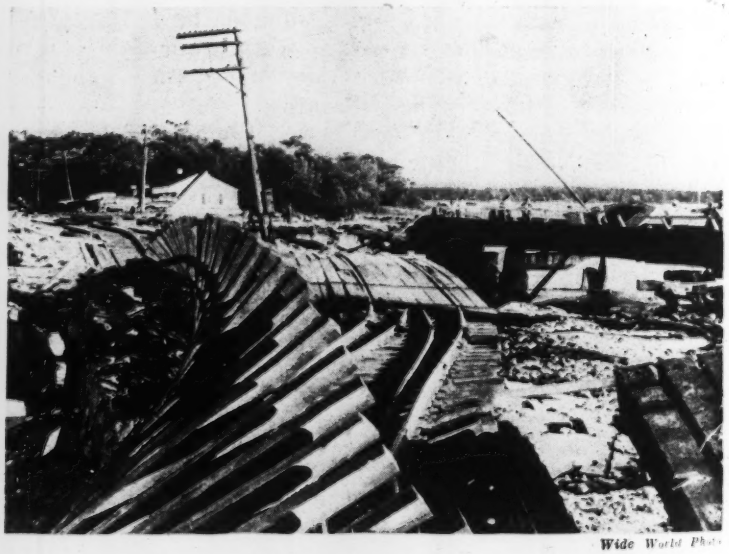
Answers to these and related matter are essential to the further development and proper understanding of sanitary fill practice. A few scattering data are available, but they afford no help to empirical practice. For those who seek an untouched field for research, the study of refuse filling offers a worthwhile opportunity.

PICTURES IN THE NEWS

Acme

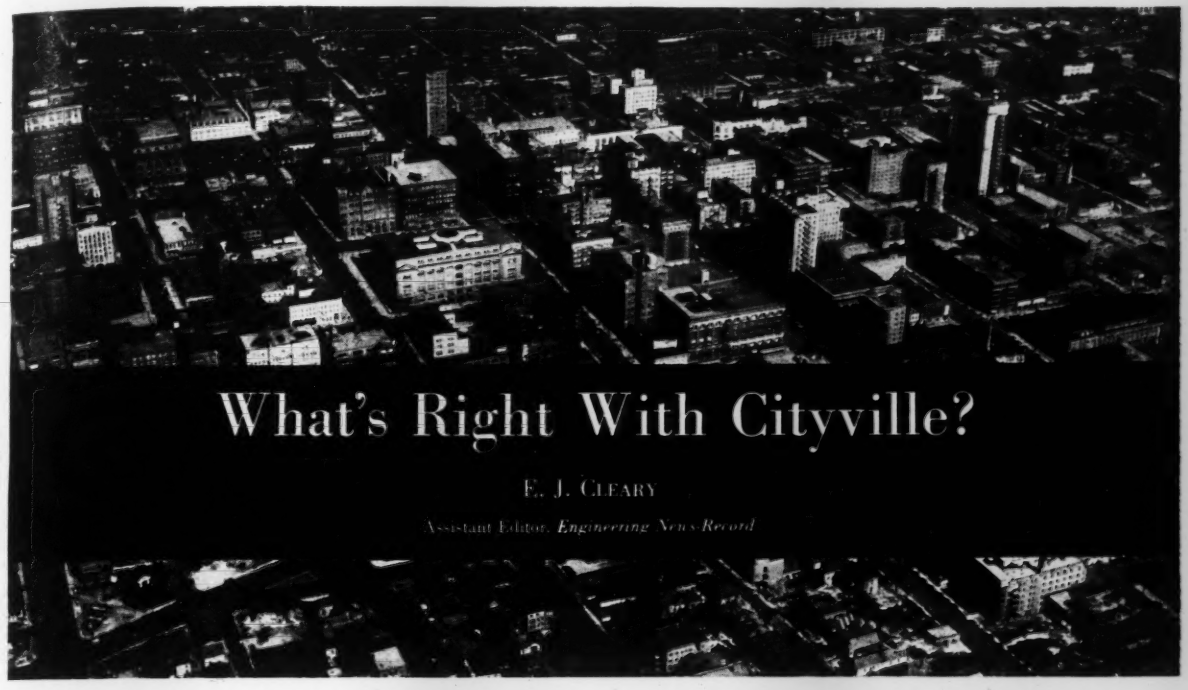
A TROPICAL HURRICANE TEACHES ITS LESSON IN A TEMPERATE ZONE. This is West Hampton, N. Y., a summer beach colony where fifteen lives were lost Sept. 21 in the storm which ravaged the upper Atlantic Coast. Built on the outer barrier beach of Long Island, the community was completely at the mercy of the wind-driven water which rose to submerge it. Such beaches are shunned by permanent structures in more tropical climes.

Acme



Wide World Photo

NO HAVEN FOR REFUGEES was this National Guard Armory (left) at New London, Conn., one of the cities hit hardest by the hurricane. Queerly enough, here the roof remained while many other buildings lost theirs—some by fires which broke out soon after the storm began. WAREHAM, MASS., (right) is the scene of this wreckage which followed the tidal wave that accompanied New England's September hurricane. The rails are of the New Haven R.R.'s line to Cape Cod.



What's Right With Cityville?

E. J. CLEARY
Assistant Editor, *Engineering News-Record*

Suppose we had to take off the blinders and put on rose-colored glasses for a look at our cities and the men who manage them

SO MUCH has been written analyzing what is wrong with Cityville, that it might be refreshing, or at least different, to say something about what is right with the place. Cityville is any municipality varying in size from 25,000 to 7,000,000 in population and scattered east, west, south and north over the United States. In common with all other communities, Cityville has public works facilities, it must provide money to build and maintain these facilities, and it needs man power to make them function. What kind of a job is being done? And is Cityville keeping up with the times and making progress toward improvement?

With these questions uppermost in mind, the writer visited Cityvilles in some 20 states and talked with mayors, engineers, public works officials, planners, street cleaners and taxpayers. As a result, the theme of this article is not how poorly off is Cityville, but rather concerns itself in an appraisal of how much it is being improved and how well it reflects the evidence of good public works management.

In making these general statements, it is not intended to imply that our cities and towns are suddenly transforming themselves into those idealistic patterns of community design and efficiency which we set up as the ultimate goal of achievement. On the contrary, the re-making of our cities to meet present needs adequately is and always will be far behind the demands that are made upon it. But this much is certain: a great deal of credit is due public works officials for the energetic manner in which cities are pushing forward their programs of improvements. Temporarily stunned by the depression, the cities have come back to the never-ending task of rebuilding with remarkable vigor.

Visual impressions

Physically, Cityville looks better. One of the major reasons for this is the attention being given to street improvement. Impressions are created by little things, and it is not amazing, therefore, to see what happens when curbs are put into alignment and street intersections are given more sweep by using a longer radius. This change not only gives the impression of orderly spaciousness but facilitates traffic movement as well.

Replacement and resurfacing operations on pavements complete the picture of well-groomed attention. In this connection, an item of considerable importance in many places has been the abandonment of street cars; this not only has permitted the removal of tracks, which in turn gives the impression of an apparently greater width to a thoroughfare but, in addition, has eliminated unsightly overhead obstructions through the removal of poles and wires.

Another item contributing to the better appearance of the city has been the refurbishing and extension of park areas. Considerably more emphasis is being placed on this phase of city betterment than ever before and it is paying dividends in the form of increased citizen pride. Parks mean recreation and today this finds increased expression in the use of swimming pools. Installation of these facilities, therefore, has become one of the most active municipal enterprises.

This was exemplified recently when, in the course of one week, a

ENR Staff Photo

Fig. 1. Utica, N. Y., recently added this quarter-million dollar pool to its recreational facilities.

Fig. 2. Street renovation programs have done much to give Cityville a "spruced up" appearance.

Fig. 3. Gone are the days of makeshift refuse collection vehicles. New York has a fleet of these smart looking, self-loading trucks.

visit at Altoona found the city engineering staff designing a large pool as the principal element in a new park development; a stop at Wilkes-Barre a few days later led to the examination of finished plans for two pools under construction, and upon arrival at Utica it was to witness the finishing touches being put on a magnificent swimming pool and bath house costing in the neighborhood of $250,000; in another part of the city a similar structure was half completed.

Airport construction and improvement is another active matter. While it is generally agreed that as a self-sustaining and paying venture the municipal airport is "out" (a recent survey of 84 cities disclosed that 78 stood a total operating loss of $1,040,000 not counting depreciation, principal or interest payments on airport bonds) the reasons for building them are sound. In some of the smaller places it has been found necessary to provide airport facilities in order to keep industrial and business firms from moving away. In other places the airport site has been selected and partly improved with an eye to the future; experience has shown the wisdom of purchasing available sites before they are adapted to other uses.

Attention to essentials

Of paramount importance in this business of remaking cities is the attention being given to those two vital essentials of community existence and wellbeing—water supply and sewage disposal. Water treatment and supply facilities have been established in our municipalities, of course, for a long time. It might be inferred, therefore, that relatively little remains to be done in this field. On the contrary, there is much activity. The principal reasons for this are threefold: (1) many of the water supply systems are old—dating back three or four decades—and they are in need of major rehabilitation and enlargement; (2) higher quality standards have been established in recent years—particularly in connection with removal of taste and hardness—and these demands are necessitating an extension of facilities; and (3) greater demands for water, stimulated by air conditioning requirements call for enlargement of supply sources as well as immediate correc-

tion of deficiencies in distribution.

Concrete evidence of a progressive attitude in municipal management is the manner in which sewage and refuse disposal services are being advanced. In the installation of sewage treatment facilities alone, more progress was made during the depression period than ever before. Why? Because of the availability of federal funds? In part yes, but behind this is something more fundamental. After all, federal funds were not advanced unless the request was made for them, the purpose for which they were to be used met with approval, and the sponsor met part of the cost. The fact that so many requests were made for aid in the construction of disposal works is evident recognition of their importance by public works officials and citizen support in the approval of bond issues or sewer rentals.

Further recognition of what constitutes proper municipal housekeeping is seen in the abandonment of hog feeding and other undesirable methods of refuse disposal in favor of incineration and sanitary fills. Forward strides are being made not only in the disposal of waste but also in collection methods. The day of the clumsy, dirty, and unsanitary garbage truck has passed into oblivion and in its place we see dustproof, clean and efficient vehicles specially designed to handle economically the work for which they are intended.

Not to be overlooked, either, in an appraisal of forward steps, are the improvements that have been made in the buildings used for the transaction of public business. Somehow, city halls do not grow old gracefully, and many of them needed revamping to properly meet the needs of today. As an indication of what has been done the following is significant: WPA, it is reported, assisted in the construction, repair and improvement of 246 city halls, and prior to 1935 federal emergency relief funds were used for work on some 1,700 city and county structures.

One of the foremost examples of municipal public building projects is the civic center in Oklahoma City. Here, some $7,700,000 was spent on the construction of three buildings for municipal purposes and a 12-story county building, all located in a cleared area in the business district. Space has been reserved for the future erection of a library.

Personnel and management

So much for things physical. A word now regarding municipal personnel and public works administration. Contrary to popular myth, City Hall is not entirely peopled with political parasites. Instead we find here workers who are just as earnest, well-trained and devoted to their responsibilities as we would meet in any efficient business establishment.

One need only come in contact with the work being done, and listen to discussions on problems of procedure and technical methods to realize that this is not the sort of thing which has its origin in the bungling efforts of incompetents. The very fact that our cities look as well as they do, provide services at reasonable cost, and constantly widen the scope of their endeavors, is a tribute to public administrators and to their staffs. And it must be remembered that these men are frequently handicapped in carrying out their programs by ill-advised councilmen and other mitigating influences that come under the classification of political expedients.

Engineers are heard

Fortunately, because of the depression, and a growing appreciation of the role of public works in the economic machine, the voice of the engineer is finding more listeners. Through PWA and WPA activities the engineer and his work have been brought to public attention. And almost without exception the public has found reason to be impressed by the administration, planning, and execution of the work undertaken. It has been repeatedly demonstrated that despite the emergency nature of much of this work, public works officials have been alert to opportunities, sound in their policies, and technically qualified to direct municipal improvements.

Unfortunately, we have not advanced very far in the development of a career concept in public service. To be sure, some progress has been made, but many basic weaknesses call for correction. It is surprising that good men continue in the public service when in so many respects, it is unattractive. Salaries are often below the standards for similar work in private business and, in addition, the lack of a well-defined merit system is a psychological as well as actual handicap to advancement. The "local boy" complex (a delusion under which many cities continue to operate)

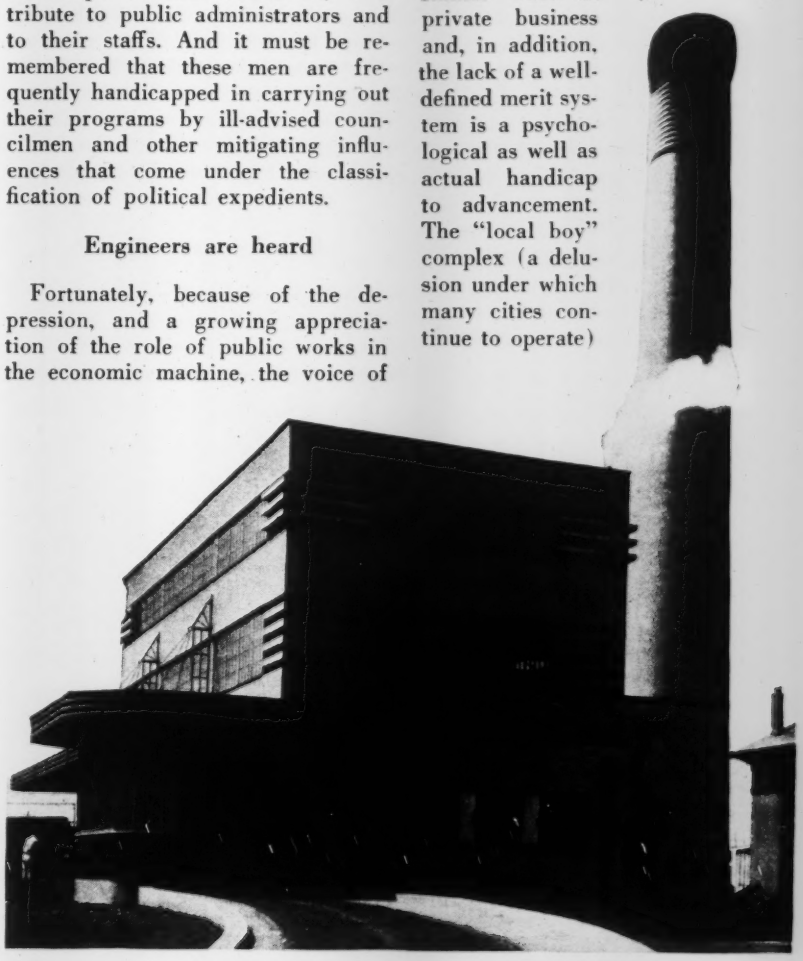


Fig. 4. Incineration answers the refuse disposal problem in many cities. This attractive building at Columbus, Ohio, houses two 75-ton furnaces.

Fig. 5. To meet the ever-increasing demands for water service cities everywhere are adding to their distribution facilities.

is a further serious handicap toward development and interchange of skilled specialists in municipal work. Too frequently Cityville insists that residence within its limits is the necessary pre-qualification for a job.

Financially, Cityville is in pretty good condition. Weaknesses in fiscal policy that were revealed during the depression have been strengthened and as a result the financial structure has been vastly improved. Other factors contributing to the betterment of city finance have been the availability of money at low interest rates and the generous apportionment of federal funds.

Among the practices which have helped to put Cityville on its feet financially has been the adoption of long range budgeting for capital improvement, refunding of outstanding bonds at lower rates of interest, and the construction of projects on a self-liquidating basis. In connection with the latter, it should be noted that the sewer system is becoming one of the favorite methods of financing sewage disposal facilities. The three general methods of rate making are: (1) a flat rate charge which is based on the type of building served by the sewer connection: (2) a flat rate schedule based on the number and type of fixture; and (3) a charge based on the quantity of consumption registered on the water company's meter.

Pay-as-you-go

Much merit is attached to the method adopted by Atlanta where needed improvements to the water plant are being financed on a pay-as-you-go basis by an increase in rates so that no bonded indebtedness will be incurred. The difference collected between the old and the new rates is earmarked and set aside for improvements only; thus diversion of funds for other purposes is prevented.

It is true that taxes in Cityville are higher than they were formerly. This is to be expected, however, because the people are demanding more services and they are getting them—at least so far as public works facilities are concerned. The taxpayer is prone to overlook this as he groans over his tax bill, but when you confront him with what he has today in the way of streets, sewer service, parks, etc., as compared to twenty years ago, he must admit that things are different—and certainly much better.

WPA a considerable aid

The role played by WPA in the remaking of our cities may have been overdramatized but, nevertheless, the fact remains that the availability of this financial aid has made it possible to carry out many long delayed but otherwise normal work programs without greatly affecting the regular budget. The principle—namely, federal financing of local improvements—is unsound, but until national philosophy in this regard is altered, there can be no logical objection to local communities accepting this financial aid and making the most of it.

What the future holds

As was stated earlier, Cityville has not been transformed into Utopia. But one cannot help being enthusiastic over the progress being made toward the elimination of deficiencies and toward a better understanding of the problems which have long cried for solution. All this is hopeful—it points to accelerated activity and broader opportunities in the field of public works. In no sense can we ever hope to catch up on requirements or expect that some day an ideal city will be completely fashioned. Technical advance and social change far outstrip the vision and ability of the planners and administrators who endeavor to keep pace with growth of all these municipalities.

The most that can be expected is conscientious endeavor and accomplishment toward remedying existing defects. This is the spirit pervading Cityville today. It is this spirit backed up by tangible accomplishments which makes an observer feel that congratulations rather than chronic castigation are in order. Look around sometime and see what is *right* with Cityville.

Circular Sheet Steel Piers Support Detour Trestle

A. BURTON COHEN
Consulting Engineer, New York

Novel trestle aids construction of notable flat slab railroad grade crossing bridges at Binghamton, N. Y.

FLAT SLAB BRIDGES of special design and a detour trestle of unusual type are features of the Ferry St. undercrossing of the main lines of the D. L. & W. and Erie Railroads in Binghamton, N. Y., whose construction was a complementary project of the Ferry St. concrete arch bridge over the Chenango River described in *ENR*, April 28, 1938, p. 613. At the site of the underpass the two railroads were carried on a common embankment, with a space about 40 ft. wide between their inside tracks. This space offered an ideal location for detour tracks to be used while the separate 3-track bridges were being built for each railroad. Some kind of a trestle support was required for the detour tracks when the underpass excavation was made, and an unsuccessful attempt to drive timber test pile for bents through 25 ft. of the compact cementitious gravel of the embankment inspired the design of a structural steel I-beam trestle deck carried on novel piers.

These piers were formed by driving steel sheet piling in 12 ft. 9½ in. diameter circles, inclosing the undisturbed earth. Five such piers were driven along the centerline of each of the two detour tracks, and were spaced 34 ft. c. to c. to support the 6-span deck. The spans were arranged to clear the retaining walls connecting the two bridges, so that these walls could be built under train operation.

No serious difficulty was encountered in driving the steel piles which were guided by a cylindrical timber template resting on the ground. Every third sheetpile was driven 2 ft. below the proposed base of the new bridge footings, and the remainder of the piles 1 ft. below the subgrade of the underpass roadway. After a cylinder was completed, the incased earth was wetted and tamped to receive a timber grillage composed of three tiers of 12x12-in. timbers to spread the track load over the entire area of the cylinder.

The Erie bridge was built first, during which time Erie trains operated over the detour. These trains were then shifted to the completed Erie bridge, and the D. L. & W. trains used the detour while the bridge for this railroad was built. Near the end of the excavation job, after the earth and pressure therefrom was entirely removed from

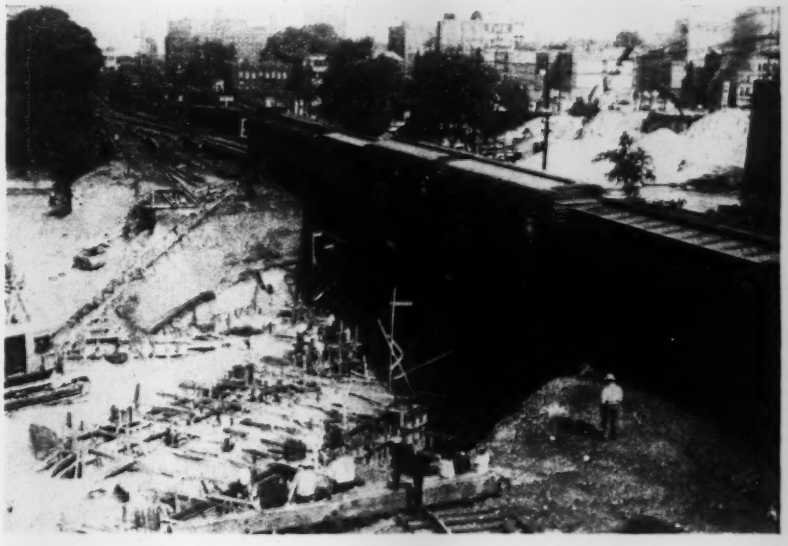


Fig. 1. Building the Erie Bridge while trains use the sheetpile pier trestle. Excavation for D. L. & W. bridge is underway behind the train

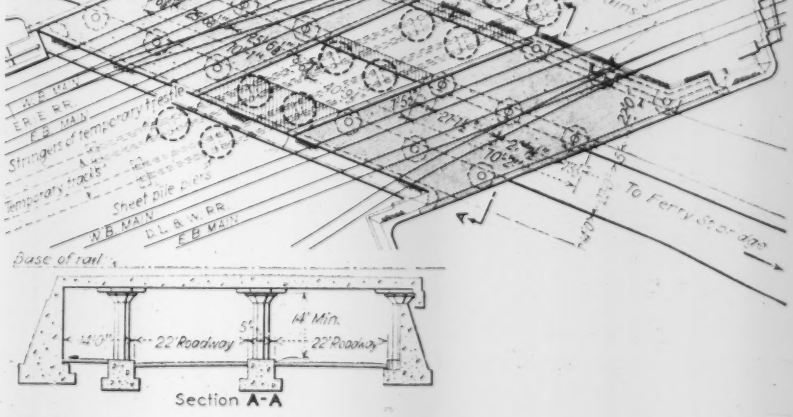


Fig. 2. Plan of Ferry St. undercrossing at Binghamton showing location of detour trestle between the two bridges which are shown shaded

Fig. 3. As excavation exposed the sheetpiling piers, they looked like this.

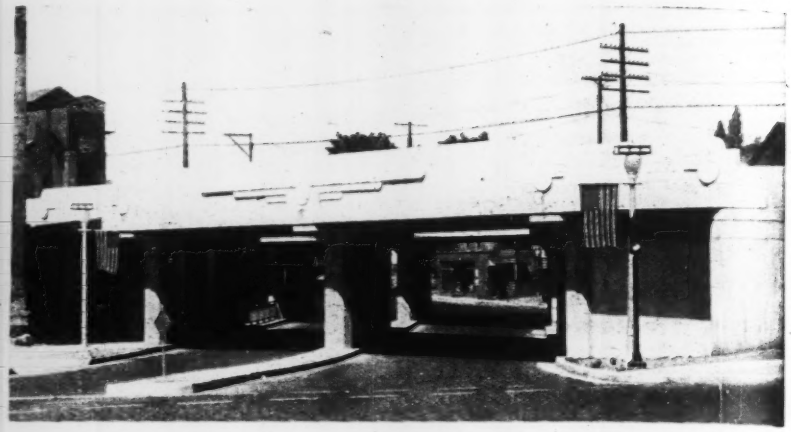


Fig. 4. Completed undercrossing of two three-track bridges as seen from the new Ferry St. bridge over the river.

around the cylinders, there was a slight settlement of the track due to a tightening of the interlocking joints of the piling; this was immediately corrected by shimming the I-beam supports, and represented very little work compared with the application of additional bracing that would have been required with a timber pile bent trestle during the period of removing surrounding earth. Furthermore, it included little of the hazard attending work around timber pile bent trestles. The wide spacing of the cylindrical piers expedited the excavation for the undercrossing, which was done freely with a power shovel. A final advantage of the design was that the piling materials could be salvaged for future use.

The pressure on the earthfill areas due to maximum track deck loading was only 1.7 tons per sq. ft. The maximum stress in the vertical section of the steel cylinder due to radial pressure of the combined earthfill and live load surcharge was inappreciable.

Bridge design features

The undercrossing design is interesting on its own account. The slab decks, parallograms in outline, are supported by three lines of octagonal columns, 3 ft. and 3 ft. 2 in. in diameter, set parallel with the street axis. One line of columns is located on the sidewalk line, the second is placed on the 5-ft. safety isle, separating the two vehicle roadways, and the third is built integrally with the east abutment, projecting beyond the abutment face in pilaster effect. The column capitals of this last row project above the top of the abutment wall to maintain plate action and continuity of the slab over the columns.

Setting the facia columns back from the face of the parapet was another expedient adopted to give better load balance on the columns. The column arrangement results in a symmetrical division of the slab area into a combination of triangular and almost square panels. The outside track crosses the exterior triangular panels parallel with their base and through the center of gravity, also tending toward a uniform distribution of all loads to the column supports.

The Erie bridge was designed for a Cooper's E-70 loading and the D. L. & W. bridge for an E-65 loading, which accounts for a slight difference in the slab thicknesses of 2 ft. 4 in. and 2 ft. 3 in., respectively at the center of the deck. The tops of the slabs slope off 2 in. to the outer edge over the abutments for drainage.

An apron or depending slab, poured with the deck, overhangs the abutment walls to reduce the horizontal thrust of the live load surcharge and the pressure of the backfill on the abutment wall section. This arrangement also facilitates drainage, water discharging over the edge of the slab and away from the abutment construction joints. A series of piles of porous stone were built up in columnar form, 10 ft. wide, 15 in. thick, and 10 ft. apart, against the backs of the abutment walls to facilitate drainage reaching an 8-in. perforated galvanized iron pipe set along the base of the abutments and adjacent walls.

The three-column bents along the curb lines and on the center safety isle are supported on continuous reinforced concrete footings in the shape of an inverted T-beam, having a stem 5 ft. wide, which projects 8 in. above the gutter to form the curb and, in the case of the westerly column bent, to form 5 ft. of the sidewalk. The narrow width of the continuous footing gives that much more space between the foundations for utility lines, sewers and gas mains. Compared with individual column footings, the continuous footing eliminates the possibility of uneven settlement of the deck slab supports. By a slight addition to the width of the thin flange of the inverted T-beam, which is the base of the footing, the soil pressure can be greatly reduced. On this bridge the footings were designed for a maximum soil pressure of 3½ tons per sq. ft. without impact. Under the toe of the abutment, the maximum eccentric pressure was limited to 4½ tons per sq. ft.

The column footings were designed for all tracks loaded except for the cantilever ends of the continuous footings. In the latter case, the loading of two tracks nearest the end of the footing under consideration resulted in the maximum stress.

The undercrossing was built by the Walsh Construction Co., Syracuse, N. Y. The writer, as consulting engineer, both to the city of Binghamton and to the railroads, designed the undercrossing and the detour structure.

Resurfacing Streets for Service

GUY C. DEWITT,
Paving Engineer, Utica, N. Y.

Experiences at Utica, N. Y. in reconstruction of wornout pavement with bituminous materials

Faced with the problem of rehabilitating many streets which had outlived their usefulness, and with only limited funds at hand, Utica, N. Y., has been actively engaged in the last two years in providing low-cost surfaces over existing pavement. The methods used, while not unique, illustrate what can be done to secure the benefits of well-paved streets at minimum expense.

Of the 175 miles of streets in Utica, 145 miles are paved. The streets in greatest need of reconstruction were built prior to 1905. These were of sheet asphalt, 2½ to 3 in. in thickness, laid on a concrete base 4 to 6 in. thick. Hand mixing or mixing by continuous mixers was customary at that time and lack of uniformity in thickness, contour and quality of concrete was the rule. In general, these bases lost almost all characteristics of concrete through deterioration, and were in effect inert and lifeless beds of crushed stone and filler. The sheet asphalt surfaces were badly checked and in many instances broken and displaced. In most cases both the surface and base were porous, and offered little resistance to the percolation of water.

In past years repairs had been made on those streets which had completely failed. Generally, upon the removal of the surface of these streets it was found that large portions of the base required replacement. And inasmuch as the property owners generally designated a 2 in. asphaltic surface to replace the thicker pavement that had been removed, unnecessarily large quantity of binder was required to bring the irregular foundation to proper contour and grade. Consequently, resurfacing operations were expensive.

Selection of surface

With limited funds available to put these streets into shape, considerable thought was given to the different methods of repair and reconstruction. Flush coats, seal coats and other surface treatments were studied as against the use of a thicker surfacing. Although the latter was somewhat higher in cost it was decided that the use of an asphaltic concrete 1½ to 2 in. in thickness laid upon the existing surface offered the greatest value. It was believed that such a surface having an inherent stability of its own could be successfully laid on the existing pavement, and that the additional thickness would add to the effective depth of pavement. Thus it would provide all the advantages of new work and also minimize the possibilities of transverse cracking.

This work was carried out by regular contract procedure although no plans were furnished. An informal survey was made of the street or streets included in the contract, the items and the quantities determined, and a short specification outlining the work to be done in that particular street was attached to the bidding sheet. The contracts usually included several streets within close proximity to each other in which the work was more or less similar in nature.

Before starting work the engineer with the inspector and the contractor went over the job and marked out

Fig. 1. With a service record of almost half a century this sheet asphalt pavement was badly in need of repair.

Fig. 2. Application of a 1½-in. course of asphaltic concrete over the old 2½-in. sheet asphalt surface put the street into first-class shape at low cost.

the work to be done. A mutual understanding was thus reached regarding manhole and other castings to be reset, curbs and curb radii to be changed, and other items that required special attention.

Following the removal of loose pavement all the depressions in the street under repair were brought to general grade and contour with asphalt binder. Dried and checked asphalt surface, wherever firm, was not disturbed and offered sufficient bond for the new surface. Trouble was anticipated in securing proper bonding over the newly patched areas so these were chinked with air hammers and sprinkled with a rapid-cure cutback.

Two methods were used at first in joining the new work with the old. The first method was to feather out the sheet mixture after chinking and sprinkling; although this was a cheaper method, it was abandoned as unsatisfactory because the thin edge wore away to leave an unsightly mottled surface. The second scheme was to cut a wide slot across the pavement, with the location and width of this slot dependent on the grade at the intersection where such joinings occurred. Great care was observed in placing and compacting the binder in these slots in order to obtain a smooth approach to the new work.

Over 90,000 sq. yd. of surfacing over asphalt by this method was completed during 1936 and 1937. The average age of the pavements so treated was 36 years and in all cases the failure of the sheet asphalt surfaces was due to age and not from wear.

While the cost of this work was greater than mere surface treatment it is believed that the greater life expectancy amply justifies the added cost. Thus far only two failures have occurred. Both of these resulted from slipping and rupture of the new surface which had been laid on a thin course of insufficiently compacted binder where chinking and sprinkling had not been done.

Pavement widening

Utilization of existing surfaces as a foundation for new surfacing has been used to a modified degree in pavement widenings during the last few years. In places where modification of the crown is necessary because of established sidewalk grades a new crown section is formed over and above the old. In such work any increase of thickness exceeding 4 inches is made with concrete. This is placed either on the concrete base or on the existing surface. Where the required thickness is less than four inches binder is used. To avoid failures thorough compaction of the binder must be obtained.

An existing concrete pavement has been widened and successfully surfaced with bitulithic composition. Prior to placing the surface in 1930 the old smooth concrete was painted with a rapid cure cut-back. This was poured on the surface and broomed about. At the present time this pavement is in good condition except that there is evidence that side slipping has occurred near the edges of the old concrete. No effort was made to prevent cracking at the transverse joints which were spaced at 30-ft. intervals. Cracking has since occurred over all the joints but no raveling has developed.

This year the surfacing of 25,000 sq. yd. of 4-strip concrete was completed. All smooth concrete was sprinkled with a rapid cure cut-back, covering not more than 50 per cent of the area so treated. Transverse joints, which occurred at 50-ft. intervals, were cleaned and where necessary poured with joint filler to secure closure. Having no knowledge of any method relative to the prevention of cracking at these transverse joints no effort was made to eliminate them. It would have been more desirable, perhaps, to have accomplished this work during cooler weather, since there would then have been less likelihood of wider cracking. Considerable amount of fine binder was used to improve the contour and section. On this prepared base was laid a 1½-in. thickness of asphaltic concrete.

We have not as yet had occasion to reconstruct pavements that are relatively modern where the need for such reconstruction is due only to excessive traffic wear. This type presents an entirely different problem. It is our thought that inasmuch as additional stability is not needed a thinner sheet surface than that used for resurfacing can be applied. This surface is to be blended into the existing live surface that is exposed to traffic. A surface heater should prove of great value in this work in obtaining the necessary depth and bond. There should be no necessity of surfacing that area near the curb reserved for parking.

These surfacing operations in Utica have been accomplished at a minimum of cost. The bid prices of pavement laid have varied from $.70 to $.85 per sq. yd. depending upon thickness called for. Incidental work including binder used to correct contour and grade has varied greatly in the different streets. The methods used have not been necessarily unique in any way but information on this type of work is decidedly meager. The engineer must rely solely on his own experience and judgment in the details involved and ceaseless vigilance is required to secure the results desired. The maintenance and reconstruction of the huge investment in paving is a matter of major importance. It is certainly of sufficient magnitude to warrant the necessary research and formulation of recommended safe practices covering such work.

The work in Utica has been under the direction of Joseph B. Shaw, city engineer. The writer is paving engineer.

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Report on Housing Projects

ABOUT 24,000 new dwelling units were made available for occupancy in the nation's large-scale housing projects during the past year, according to the National Association of Housing Officials. Nearly 37,000 families now make their homes in federally-aided projects located in all parts of the country. Tenants are now living in 51 housing projects financed by the Housing Division of the Public Works Administration and its successor, the United States Housing Authority; in 82 Farm Security Administration projects; and in 13 large-scale rental projects financed through the Federal Housing Administration.

In addition to the dwelling units already occupied on May 1, the three federal housing agencies list other projects, approved or under construction, which will provide 25,000 more homes. The USHA lists 23 such projects; the FHA, Rental Housing Division, 62; and the FSA, 2. Since May 1, USHA contracts have been approved for 21 cities which would supplement the total by nearly 21,000 dwelling units.

FIG. I. TYPICAL GEORGIA EARTH ROAD OF DOUBLE SURFACE-TREATED TOPSOIL

Earth Roads in the South–IV

C. S. HILL
Associate Editor, *Engineering News-Record*

Georgia

Georgia with its wide range of road soils capable of natural stabilization furnishes a fine study in soil characteristics and methods of base construction

A NOVELTY in management is run into almost as soon as one looks into Georgia highway affairs. There is a state system (about 10,740 mi.) and there are county roads and in addition there is a division of the state highway board created in 1937, known as the U. S. Rural Post-Roads Division that has certain powers of direction over nearly all roads outside the state system. At the present time the post-road mileage is nearly 13,000 mi. It is, however, the main state roads that exemplify earth-road practice in Georgia.

Coming out of Alabama into Georgia one is impressed by the similarity of practice in earth-road construction by the two big southern states. The likeness is in broad principles, it should be said, and not in details. Georgia like Alabama has a wide spread of soils that are stable in themselves or can be made stable by combining and selecting proper parts of two or more. In fact Georgia is rather fortunate in its distribution of types of road soils. Except in the coastal-plain zone where sand prevails and calls for processing with artificial binders, self-stabilizing soils predominate, and since a small part comparatively of the road mileage is in the sand zone it is fair to say that Georgia earth roadbuilding is: Stabilized bases of proportional local soils with a single or double surface treatment for the wearing course. Fig. 1 is an excellent example of one of these roads.

Soils used where they are

Georgia engineers do not pick and fetch soils from all around the state for stabilized bases, they take the soils where they are and make stable base mixtures of them. Incidentally this is the practice of every southern state visited, and so each has a design section for about every kind of soil. In Georgia these number half a score as shown by Fig. 2 with still others designed for the occasion where special local soil conditions exist.

Illustration is chosen as best exemplifying the point being made of variety. Each section shown is of an actual road; all present features in common that indicate holding to a tried standard but also differences that indicate no slavish adherence to standard. This is a fact of importance; there is no one standard earth road section in Georgia nor in any southern state; each road has its own section designed for it and sometimes differently for different parts.

Perhaps the definition might be: Individual design grafted onto a standard.

But the thought started with was not road sections but that in base construction the soil is used where it is. This of course is not wholly true; in some places the soil is really bad and then soil that is capable of ready stabilization is borrowed but always from as nearby as possible. Again some soils require different soils to be mixed with them to make them stable. Materials for stabilized base are therefore not a hit or miss choice of what is at hand; they are natural or synthetic mixes determined by analysis. And this brings the problem to the soils laboratory. The role of the laboratory as W. F. Abercrombie, assistant materials engineer described it is:

In developing the plans for construction, possible sources of base materials are located; the sources are located where the material is best but also with an eye to keeping the haul short and particularly to reducing overhaul. Before any source is designated for the contractor's use, tests are made. Is it a stable mixture as it is found (some of these soils often are) or is some element lacking which must be added? The laboratory answers these questions and if modification is necessary it tells what materials should be added and how much of each. Then the mixture is set up for the contractor to produce, and all through construction, check tests are made to make sure that it is being produced.

Concise as this statement is no soils engineer will fail to understand the labor and technique involved.

What are the base soils?

As will be seen from Fig. 2, Georgia has and uses about every type of base soil that is used in southern earth road construction. It even has limerock, which is Florida's outstanding earth road material. What are these soils? Of course the answer must be in general terms; nature has not laid down her soil mixtures by formulas. But in general terms the answer is reasonably precise.

Topsoil is one of the most common materials; by and large it is perhaps the most distinctive roadbuilding soil of all the southern states and in all these states (Florida is the only exception) it was used for making roads long before modern engineering practices took command, and, by the way, have somewhat confused definition. As used in earlier roadbuilding, topsoil is a natural sand-clay of pebbly character found in surface deposits of limited depths; this is also today's engineering defition. But today included in the same category for road-base construction are: (1) natural sand-clays wherever found in surface or sub-surface deposits of considerable depths, and (2) artificial mixtures of sand and clay in stable proportions.

For road bases the required physical properties for all of these materials is about the same. In Georgia the proportions preferred are: Clay, 9 to 18 per cent; silt, 5 to 15 per cent; total sand 65 to 80 per cent and proportion of sand retained on a 60 sieve 45 to 60 per cent.

Clay-gravel almost defines itself, natural mixtures of gravel, sand and clay are familiar to everyone. For road base Georgia requires 80 to 100 per cent to pass 1½ in. and 25 to 55 per cent to pass 10-mesh. The smaller than 10-mesh part is considered as binder and is required to contain 7 to 25 per cent clay; 0 to 15 per cent silt; 55 to 90 per cent sand, of which 35 to 85 per cent is coarser than 60 mesh. *Sand* again needs no definition. It is stabilized by bituminous binder or portland cement for base construction, and as Florida and the two Carolinas have gone farthest in experimentation most complete consideration is given in the articles on those three states. Stone, crushed, is used for road base constructed as waterbound macadam or stabilized by a soil binder (top-soil or sand-clay) or by chert.

Two of the road base soils of Georgia not very familiar to roadbuilders outside of the South are pebble soil and chert and the latter is an even more common base material in Alabama. *Pebble soil* is found over a wide area of Georgia. Pebble soil is a curious deposit consisting of rounded pebbles of iron oxide from fist to buckshot size mixed with sand clay. As used for base the requirements are 80 to 100 per cent passing 1½ in. and 25 to 80 per cent passing 10-mesh. The binder requirement is clay 11 to 25 per cent, silt 0 to 15 per cent and sand 55 to 90 per cent, and of the sand 30 to 85 per cent must be larger than 60-mesh size.

Asked what chert is a southern roadbuilder will answer: "Why, it's chert." And he knows perfectly what he means. As an attempt at definition let us say that *Chert* is a rocky amorphous silica containing clay or dust of fracture; is hard, is often found in a broken down form like disintegrated granite but containing large fragments that have to be crushed. As specified for road base in Georgia, 80 to 100 per cent must be under 1½ in., 20 to 40 per cent must pass 10-mesh. Of the finer part the composition required in percentages is: Clay (dust of fracture) 15 to 50, silt 5 to 25, and sand 25 to 80, of which 15 to 80 per cent is larger than 60-mesh.

Adding limerock, most used in Florida but also in Alabama and Georgia, to this rather drab cataloging and we have about all the earths largely used for roadbuilding in the six southern states represented in these articles. To the roadbuilder the details of selecting and processing these earths are all important and also full presentation runs into a large volume of details that cannot be given here. The more important thought to be clung to is that modern soils mechanics is giving the means of using about every kind of mineral soil anywhere to produce substantial roads.

How bases are built

Bases in Georgia or in any southern state are not built on any kind of subgrade that happens to be available; all subgrades are built to modern engineering standards. These include sound soils (obtained by replacement if necessary); removal of stones; scarifying and working to uniform density; shaping to profile (See Fig. 2) and ditching and other drainage construction. The standards are common and familiar to every roadbuilder and details are unnecessary.

With the variety of soils used for road base it could be supposed that equal differences in construction methods and equipment naturally follow. They do not. Limerock bases require individual treatment, as described in the article on Florida, and processing sand with bitumen of cement is quite a separate operation, but for topsoil, sand-clay, clay-gravel and pebble soil bases the operations are alike, indeed the Georgia engi-

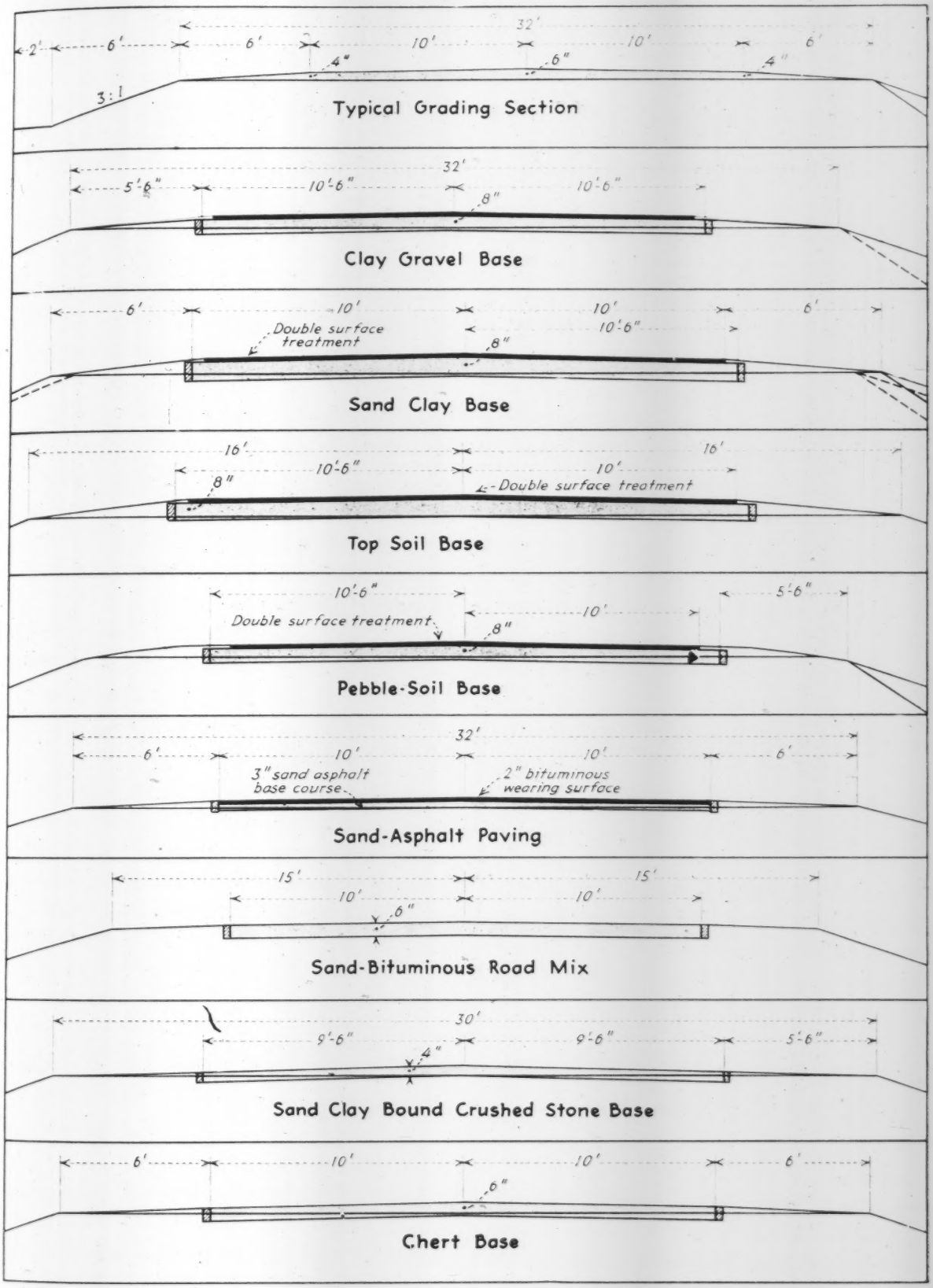

Fig. 2. Examples of stabilized and processed soil road bases as designed for earth roads recently constructed in Georgia.

Fig. 4. A typical topsoil base in Georgia being mixed with a tractor-hauled disk harrow.

neers write one specification for all four bases and the specification for stabilized crushed stone base construction is not really different.

Methods of processing sand with bitumen are described in the article on Florida (*ENR Sept.* 8, 1938) and will be discussed again in the articles on South Carolina and North Carolina. It is proposed to center attention here on the way the Georgia engineers handle their topsoil, sand-clay, clay-gravel and pebble soil bases. In general the methods are typical of all southern practice. Broadly there are three operations: Spreading, mixing and compacting. As previously stated the sources of base material are selected by the engineers and the laboratory has determined that the materials are suitable and in what proportions they are to be used.

Spreading—Georgia practice is to build the base course between side forms as shown by Fig. 2. These are kept set 200 ft. or farther ahead of where base material is being deposited. So that the special material is not traveled over, depositing is started at the end of the work farthest from the pit. The base material is spreader dumped and smoothed to depth as shown by grade blocks or checked by a templet screed riding on the side forms. Then comes the very particular process of mixing.

Mixing—The mixing process varies with conditions. Roughly there are five conditions or six if a surface stabilizer aggregate is used. To prevent confusion these conditions will be considered in numbered order.

1. The first case is where the base is to be a mixture of two materials occurring in separate layers one under the other in the same pit. At the pit the two materials in specified proportions are thrown up in windrows and mixed by turning them over into each other several times or by sifting them together through a shovel dipper. As soon as 1,500 to 2,500 ft. of the pit-sized material has been spread mixing in place begins; the spread material is plowed and then disk-harrowed and these processes are repeated as many times as is necessary to mix and pulverize the base thoroughly. If check tests then show any part of the base mixture to be deficient in sand, clay binder or coarse materials, the lacking material is added and mixing is continued. After mixing, the base is machined to profile and section, is rolled and then opened to traffic.

Mixing two materials

2. When the base is to be a mixture of two materials from separate sources they are spread in successive layers in the order and in the depths specified and then mixed in place. In Georgia two processes are used and they are a little particular. (1) Not later than the day following spreading, the base is plowed and harrowed. The first plowing begins at the edges turning the furrows away from the center for the full width and depth of the base course. Then the plowed material is thoroughly disk harrowed. A second plowing begins at the center turning the furrows toward the center and the plowed material is again harrowed. These operations are repeated until the mix is satisfactory. (2) In lieu of plowing the material is bladed in windrows back and forth across the road until thoroughly mixed. The remaining processes are as in the first case.

3. The same process is employed as in case 2 when old roadbed material is scarified and mixed with added pit material.

4. When the pit material is of the proper composition in itself the spread base is mixed as described in case 1.

5. When old road base material alone is to be reprocessed and reshaped the material is scarified and harrowed and refinished as described in case 1.

The use of stabilizer aggregate is only occasional and always supplementary to the regular base course procedure described. A layer of the aggregate of a volume directed by the engineer is worked by harrow or blade grader into the top 2 or 4 in. of the base until a uniform mosaic-like surface is obtained.

Compaction — The requirements for base course compaction are in no

way less rigid than those for spreading and mixing. Given soil mixtures that have the qualities that give stability it is held to be just as vital to get stability by compaction and bonding. This involves proper moisture content obtained by sprinkling if necessary. Compaction is normally obtained by rolling, but traffic compaction is permitted when traffic is deemed heavy enough and is evenly directed.

Rolling is the normal procedure, generally with smooth rollers but the sheeps-foot roller is coming in on natural soil bases as in Georgia and Alabama and is common on cement or bitumen processed soils in the Carolinas. Georgia requires a three-wheel 10-ton roller for base compaction. First, however, the shoulders are built up to full dimensions (Fig. 2) and the side forms are pulled. The roller is then required to work in toward the center from each edge with a one-half rear-wheel overlap, the operation to be continued with alternate blade-grader dressing until full compaction to a 10-ft. straightedge variation of not over ½ in.

All bases armored

In presenting base construction methods it is obvious that they apply only to stabilized natural soil bases. Processed soil base construction is a different technique as is described in the articles on practice in Florida and the Carolinas. Also it hardly needs to be said, no state does its work identically like all the others; the procedure differs in details but Georgia practice is representative in general procedure and in the equipment used.

Like every other state of the South, Georgia armors its bases with a bituminous surface treatment substantially like that described more in detail in the article on Alabama.

Georgia roadwork is directed by a state highway board of three members. E. A. Stanley is state highway engineer. The writer is indebted for much patience in explaining details to J. H. Archer and W. F. Abercrombie of Mr. Stanley's staff.

As has been mentioned in this and preceding articles the Carolinas offer striking examples of soil processing with bitumens and cement and in the next article some of the work of South Carolina with cement and tar will be outlined.

Subzero Concrete Pumping

F. A. DALE

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Pump placement of concrete in a northern Maine winter required no unusual frost protection

CONSTANT PROGRESS in the pump placement of concrete was recorded during the past winter at Solon dam on the Kennebec River in northern Maine. Temperatures were as low as —20 deg. F. Pumping met the severe frost conditions in a rather scattered layout of structures as shown by Fig. 1. To advance the story a little, some of the questions that came up during the study of plant layout have been answered as follows:

1. There is no need of insulating the concrete pipeline to prevent freezing or excessive drop in temperature. With an air temperature of —12 deg. the concrete dropped only 6 deg. with an exposed pipeline length of 280 ft.; the pipe was prewarmed by steam before pumping was started.

2. Slumps as low as 1½ in. at the mixer were pumped without difficulty. Thick grout for surface bonding was readily pumped and it was possible to alternate from grout to concrete or from concrete to grout by simply changing valve settings.

3. In some cases the pipe discharge was 29 ft. below the pumping machine. No segregation or plugging occurred, although care was taken to have any steep drops followed by enough friction to counteract the drop, thus preventing separation of the concrete column in the drop.

4. Pumping could be stopped at least 20 min. without plugging. This was ample time for changing chutes or shifting points of discharge along the pipe. Ordinarily only a few minutes stop was required for these purposes.

5. Transporting the concrete from pipe outlet to final destination in the form was satisfactorily accomplished by coal chutes. Lengths of from 5 to 10 ft. were found to cover all conditions and were conveniently handled where the clear width, within the form, was 3 ft. or more. No separation of the concrete stream was caused if the chute slope was just steep enough to keep the concrete moving; this minimum slope was found to range from 4 vertical to 12 horizontal (1 on 3) for 4-in. slump, up to 7 on 12 for 1½-in. slump. The chutes were suspended at the correct angles by wires attached to the form tie rods. Fig. 2 shows a typical arrangement of chutes in a pier form.

6. Behavior of concrete during transportation is dependent on the shape and grading of the aggregates and on the mix proportions. Some variation in the above data might therefore be expected for different concretes.

Placing lessons

The aggregates were two sizes of stone and two sizes of sand, the separation being 2½ to 1 in., 1 to ¼ in. and minus ¼ in. The aggregates were stockpiled over a reclaiming tunnel before severe weather set in and were transferred to the batching-plant storage bins by belt conveyors. Batching was by weight for the aggregates and cement; water was measured by an adjustable siphon volumetric tank.

All concrete was puddled by internal electric vibrators; in addition, unformed surfaces were consolidated by a surface vibrator consisting of an internal vibrator mounted horizontally on a 12x48-in. board. It was necessary to have the forms very tight; otherwise water is driven through the joints between boards, carrying cement and fine sand with it and causing a narrow sand streak on the concrete surface along the open joint. The steepest surface possible without forms, using 2-in. slump concrete vibrated, was 1 vertical on 3½ horizontal. Steeper slopes were roughed formed, stripped after 1 to 2 hr. and the surface floated.

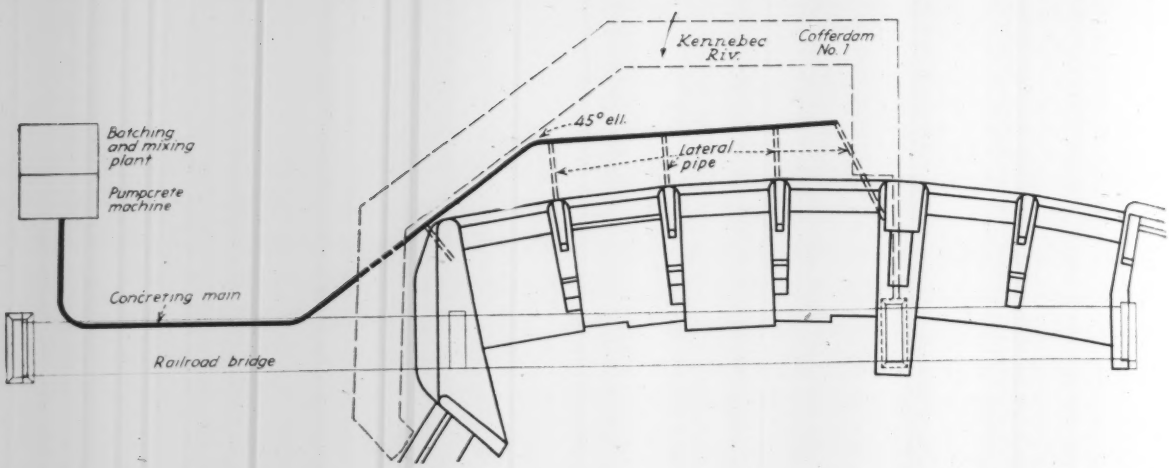


Fig. 1. Solon dam and pipe line and chute arrangement for placing concrete by pumping in subzero weather.

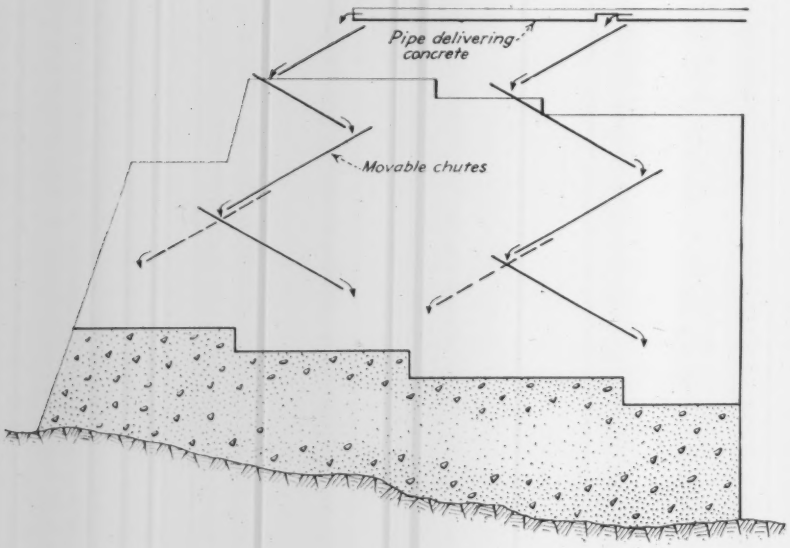


Fig. 2. Chute arrangement for distributing pumped concrete inside the pier forms.

Horizontal construction joints were defined along exposed edges by pouring against a grade strip fastened to the form; in from the edge the joints were left irregular. From 6 to 10 hr. after a pour, the bonding surface was cleaned by a high-pressure jet of air and hot water. This removed some of the surface mortar without disturbing the coarse aggregate and left a rough surface. The jetting must be done at the right stage of set when the mortar will cut but the stones will not become loosened.

Anticold measures

No difficulty was experienced from frozen stone since the sizes used were self-draining in the stock pile. The sands were wet and the surfaces of the pile froze to a depth of several feet. As the craters above the tunnel gates formed and enlarged, it was necessary to break up the frozen surface lumps by using live steam at the pile. No difficulty was experienced in the flow of any of the aggregates from the storage bins, the bin sides having a slope of 1 vertical to 1 horizontal.

The entire batching and mixing plant was enclosed and heated. Dry steam coils surrounded the aggregate storage bins and in addition, live-steam connections into the bins were provided. Live steam was necessary only in very cold weather; its use made the control of mixing water difficult.

One advantage of pumping concrete at low air temperatures is that the form can be completely enclosed on top and the pipe line over the form included within the enclosure. The entire space involved in the placing operations can therefore be kept warm. As a result, the freshly placed concrete is protected from freezing without the need of high placing temperature and the efficiency of the workmen is greatly increased. On only one occasion was concreting postponed on account of low temperature within the form; a strong wind down the river with zero temperature delayed operations for half a day.

With a large area of surrounding ledge continuously exposed to cold, it was impossible to heat the rock base of a pour much above freezing. Concrete for bottom pours was therefore kept down to about 40 deg. F. placing temperature so as to reduce the maximum difference in temperature between concrete and ledge and thus reduce the tendency of the concrete to crack when cooling. In mass spillway pours where most of the heat of hydration had to be dissipated from the top surface, the base pour was limited to about 5 ft. deep. The covering pour was placed after the pour below had passed its maximum temperature but before it had cooled below about 50 deg. F. Concrete was protected from freezing for two weeks after pouring. After the forms were stripped, tarpaulin covers with live steam jets beneath were used.

Pumping outputs and costs

Fig. 2 shows a typical pipe and chute arrangement for a pier pour. The pipe is hung from a cable which

is supported independently of the form so that pipe motion is not transmitted to the form. Pipe bends must be anchored securely to resist the impulses of the pump pistons. After each pour the concrete in the pipe line is reclaimed and the pipe cleaned, by breaking the line at the pump, inserting a go-devil and forcing it through with air or water. Air works satisfactorily for lengths up to 400 ft. with 90 lb. pressure. The pressure must be shut off before the go-devil reaches the end of the pipe, otherwise the explosion of suddenly released air is rather violent. The position of the tail end of the concrete column can be easily followed by hammering the pipe. For a length of more than 400 ft., air pressure is not sufficient and water is pumped by the concrete pump with valves set to full closure. With this method, pumping is stopped just before the water reaches the end of the pipe and the water is drained out by opening the pipe at a low point.

The cost of handling aggregates and concrete amounted to $1.70 a cu.yd. This is the labor cost for: Handling aggregates from stock piles to batcher bins, batching, mixing, transporting and placing concrete, including labor operating the pumping machine and installing pipe lines. The cost of heating aggregates and concrete, before and after placing, amounted to $0.39 per cu.yd.

The capacity of the twin pump was about 37 cu.yd. per hour with 2-in. slump concrete, and higher for larger slumps. The 1-yd. mixer limited the plant output to about the same figure with 1½-min. mixing time. The actual rate of placing varied from 20 to 29 cu.yd. per hour depending on the amount of delays in preparation of the forms.

The Solon dam is being built for the Central Maine Power Co. under the direction of Frank Mason, chief engineer. The writer acted as Mr. Mason's representative and A. C. Blake was concrete technician. The Sanders Engineering Co. was the contractor, with J. A. Hamilton as superintendent.

Boston Host to N.E.W.W.A.

Waterworks men discuss construction costs, industrial requirements and cross connection tests and hazards

WAYS AND MEANS of evaluating the cost of water supply projects for comparative purposes, and a symposium on problems encountered in supplying water for industrial and air conditioning use were highlights of the technical discussion during the three-day meeting of the New England Water Works Association in Boston on Sept. 13–16. The 700 delegates and 80 manufacturers who were present also had an opportunity to witness the first major showing of a three reel talking picture on the development and use of cast iron pipe, produced by the Cast Iron Pipe Research Association.

Taking a determined stand on the elimination of potential hazards caused by improper water supply connections and fixture installation which now are not subject to examination or inspection of any local authority, the association unanimously endorsed resolutions directed toward this end. Among other things, the resolution (1) voiced opposition to the existence of unprotected cross connections; (2) urged that an authority be established in each municipality whose duty it shall be to pass upon the installation of fixtures and piping; (3) recommended that Section 909f of the National Electrical Code be followed with reference to grounding of light and power circuits on water pipe and (4) requested the cooperation of manufacturers, architects and designers in preventing the manufacture and installation of improper plumbing equipment and devices.

Water system costs

"How much does a water supply system cost?" That was the knotty question to which a symposium was directed in an effort to determine comparative cost data on projects of various types and magnitude. The four papers which were presented and the discussion led by Frank A. Barbour, consulting engineer, Boston, did not find the answer, but a good start was made toward developing a fund of information from which general conclusions may later be drawn.

George A. Sampson, of Weston & Sampson, consulting engineers, Boston, told what he had found in making a study of basic factors affecting the cost of surface water supply projects in New England. The more important of these were, in brief:

Waterworks built prior to 1916 cost about half as much as those constructed since that date.

In a cost index, where the year 1937 is assumed to be 100, the index figures for other years would be: 1930, 90.5; 1925, 98.1; 1920, 130.5; 1915, 51.4; 1910, 50.9. Estimates using a per-capita-served unit were a more accurate basis for determining costs than such units as million-gallons-per-day capacity, or cost-per-service.

Data from 12 projects on the combined cost of source, protection of source, treatment of water, method of supply, secondary storage requirements, show that these parts of the system range from $10 to $60 per capita served, with a probable average cost of $23.

Distribution systems will average from 65 to 75 per cent of the total cost of a water system.

The present average cost of installing mains (using a weighted average in size from 4 in. up) is $1.93 per lin.ft.; if nothing smaller than 6 in. is used, the average cost would be $1.96.

The cost of hydrants and 6-in. connections to the main, including gate valves, averages 13.5 per cent of the cost of the pipe in the distribution system.

Average cost of a service connection (serving 4.3 persons) without an allowance for pavement work, will be about $38. Removal and replacement of permanent street pavement and sidewalks will increase construction cost from $0.50 to $1.50 per lin.ft.

Estimates of construction cost should be increased by 15 per cent for legal services, engineering, interest charges, contingencies, etc.

Groundwater supplies

In discussing the cost of groundwater supplies (which were divided into three types—dug wells, tubular wells and gravel-packed wells), Paul F. Howard, Whitman & Howard, consulting engineers, Boston, said that no general conclusions might be drawn as to what type of development is the most economical. Factors more important than cost will usually determine the choice of the type of well to be used; these involve permissible pumping rates, ground formation, characteristics of the water and maintenance costs.

Relatively little cost data are available on dug wells because so few have been built in recent years; one project involving two wells with a concrete lining, each of 1 m.g.d. capacity, cost $17,000.

Tubular well installations, in most of which 2½-in. pipe is used, may vary in cost from $1,680 to $2,016 per 100,000 g.p.d. per well developed; to this must be added the cost of pumping and auxiliary equipment which will be $7,600 for each 100,000 g.p.d. capacity.

Figures on gravel-packed wells indicated a cost of $1,070 to $1,430 per 100,000 g.p.d. per well developed; pumping and auxiliary equipment cost added $5,300 for each 100,000 g.p.d. These costs did not include land and engineering fees.

In speaking of the cost of distribution systems, W. W. Brush, editor of *Water Works Engineering*, pointed to a number of variables which may affect costs, such as character of excavation, subsurface congestion caused by other public utility structures, street traffic, and pipe layout design. Data from 14 New England cities gave an average cost per distribution system (exclusive of services and meters) of $47 per capita; the minimum was $24 and the maximum $69.

To illustrate the variation in construction cost due to subsurface conditions and street traffic, Mr. Brush cited data from Chicago on the installation of mains in 1930. Cost per foot of a 6-in. main in an unimproved street was $1.45 as compared with $9.08 in improved areas; for a 12-in. main the costs were $5.88 and $10.65.

Operating and maintenance practice varies greatly without apparently any compelling reason, said Mr. Brush, and this is reflected in the cost data. Statistics from 14 cities in New England (population 11,000 to 500,000) showed the annual cost to vary from $0.26 to $4.56 per capital.

In the discussion following the papers it was pointed out that lack of standardization of valves and other accessories would lead to higher maintenance costs. One instance was cited where a certain city used 13 different kinds of gate valves of different sizes and consequently several thousand repair parts had to be carried in stock.

Industrial water requirements

In a symposium on miscellaneous uses of water, presided over by W. D. Collins, chemist of the U. S. Geological Survey, Washington, industrial requirements in air conditioning needs were reviewed. Mr. Collins stated that although government charts are available showing the average characteristics of water in different regions, they must be used with caution since average conditions may not apply in specific localities. In fact, there are some instances where wells within a short distance of each other may produce water of entirely different characteristics. A single analysis of a surface supply, likewise, is misleading, because in different seasons of the year the composition may vary over wide limits.

Conditioning water for specific industrial requirements cannot be standardized as is municipal treatment practice, said Sheppard T. Powell, consulting engineer, Baltimore, because of the wide variation in quality desired in different industries. Broadly speaking, industrial water needs fall into three classes: cooling and condensing, processing, and steam generation.

Of primary importance in water used for cooling are the temperatures and turbidity of the supply. Since groundwater supplies are lower in temperature than surface water, it was suggested that cities might consider preferential apportionment of groundwater for industrial use.

The preparation of water suitable for processing uses, the availability of zeolite materials of non-siliceous types, was held to be the most interesting recent development. Both carbonaceous and resinous zeolites were mentioned as having wide applications in water softening, and capable of producing a water approaching that obtained from evaporative or other distilling apparatus. Deaeration and control of pH value were cited as satisfactory methods of reducing the corrosive quality of boiler feed water. A further control measure is afforded by the removal of non-condensible gases from the water by means of vacuum deaerators, said Mr. Powell.

Water quality requirements for New England industries were outlined by H. A. Skinner, Skinner & Sherman, consulting engineers, Boston, who stated that chemical engineering knowledge was a necessary adjunct to the design and operation of treatment plants in manufacturing establishments.

Air conditioning needs

Water requirements for air conditioning were discussed by W. H. Sears, mechanical engineer, Metropolitan District Water Commission, Boston, who pointed out that 15,600 gal. per person was the average requirement during the summer season of 120 days. On this basis, if air conditioning devices were installed to serve 50 per cent of the population, the extra demand would be equivalent to 22 gal. per capita per day.

The use of cooling towers and similar devices would permit reuse of 90 to 95 per cent of the water for cooling. There is an increasing tendency to use these conservation devices but they are not in general use. For the country at large, 60 per cent of the capacity of the installations that were made in 1935 were equipped with water-saving devices. Figures provided by the Carrier Engineering Corp. show that the average water requirement of 15,600 gal. per person could be reduced to 780 gal. if complete use were made of evaporative condensers and cooling towers.

Records of the local electric utility company are helpful in estimating the amount of water used for air conditioning, said Mr. Sears. Information is kept on the horsepower of motors connected with air-condi-

tioning equipment, and since one horsepower is required for each five persons, the total number of persons for whom air conditioning is to be furnished can be determined. This figure multiplied by the per capita requirements gives the total capacity needed.

Using the above scheme of calculation, Mr. Sears estimated that the maximum demand for air conditioning in Boston would be 22 m.g.d., if no water conserving devices were used. The utility company records show, however, that about 45 per cent of the air-conditioning devices are equipped with water savers; therefore, the maximum demand would be only 12.6 m.g.d.

Fire fighting needs

The use of larger pumping equipment in fire fighting apparatus and the practice of operating it to near capacity may result in demands for increased water supply, according to George W. Booth, chief engineer, Committee on Fire Protection of the National Board of Fire Underwriters, New York. The supply of 500 g.p.m. from an individual hydrant was formerly sufficient, but present requirements call for 750 g.p.m. and even 1,000 g.p.m. in some cities. The increased demand may call for larger and better designed hydrants than are now used, and will render obsolete any with friction losses in branch and barrel exceeding 20 lb. for a 1,000 gal. flow.

Recommendations for improving fire fighting facilities were:

Use of more elevated storage.

Elimination of dead ends from the distribution system and the replacement of 4-in. pipe by 8-in. mains where the gridiron is incomplete.

Installation of hydrants at a ratio of 1 to each 110,000 sq.ft. of occupied territory, with closer spacing up to 1 to each 40,000 sq.ft. in high value sections of the city.

Use of 12-in. pipe for gridironed high value areas.

The Biddeford plant

How record high water in the Saco River at Biddeford, Maine in the March 1936 flood affected the design of a new treatment plant was described by E. T. McDowell, superintendent of the Biddeford & Saco Water Department. A new plan incorporating flood protection features was drafted, the location of the electric substation was moved to higher ground, and all underground wiring was eliminated in favor of overhead connections. The filter plant and pumping station were inclosed by watertight concrete walls carried to an elevation several feet above the peak of the March flood.

Another of the interesting features of the plant is the provision made so that none of the walls backed by water is exposed to the outside air. A separate wall, removed from the walls of the filters and clear well by an 8-in. air space, is expected to eliminate the possibility of concrete disintegration caused by water seepage in cold weather.

Cross connection tests

Because Connecticut temporarily has permitted cross connections with non-potable supplies provided these connections existed prior to the adoption of prohibitory measures in 1926 and provided double check valves are used, the State Department of Health conducts regular tests of these installations. These tests are made every four months and are designed to reveal any possibilities of leakage or physical impairment of the double check valves.

Based on the results of 12 years' experience with check valve installations, F. O. A. Almquist, senior sanitary engineer of the State Department of Health, said that a great degree of reliance can be placed on these valves for safeguarding public water supplies. This statement was qualified by adding that the valves must be of an approved type, preferably of all bronze construction, and they must be properly maintained. Required maintenance should include periodic inspection and the opening of the valves for thorough cleaning and overhauling at least once a year. Mr. Almquist emphasized that new cross connections, even with check valve protection, are not allowed in Connecticut, and the old connections are being eliminated as fast as possible.

In reporting on experiences with double check valves in New Bedford, Mass., Stephen H. Taylor, superintendent of the water department, said that of 1,694 inspections made during 1933–37, there was no case where both valves leaked, and only one case where one valve was found to be leaky. Records over a 27-year period of test inspection showed that the rubber facings of check valves have an average life of ten years, although several facings have served for 25 years.

Geology and water supply

How the geologist can help the waterworks man in locating groundwater supplies was explained by Irving D. Crosby, consulting geologist, Boston, Mass. Taking the Massachusetts area as an example, Mr. Crosby traced the geological development which led to the filling of pre-glacial valleys with deposits that are water-bearing. After the valleys are located, certain geological clues will aid in discovering the most likely spots where sand deposits may be found; exploratory drilling for this purpose is usually too expensive.

Among the modern methods of prospecting for water, the geologist places considerable reliance on the application of seismic geophysical prospecting for locating valleys which have been filled with pre-glacial deposits.

In Massachusetts, 14 per cent of the total area of the state is devoted to watershed purposes, according to F. H. Kingsbury, senior sanitary engineer of the state department of health, who presented the highlights of an exhaustive study of surface water supplies. A total of some 205 sq.mi. of land is used for water storage which serves about 75 per cent of the population. Among the data presented was a study of the variation of chloride content which shows that at one mile from the ocean the amount was 15 p.p.m.; 22 miles away the chloride dropped to 2.5 p.p.m.; and at a distance of 120 miles analysis showed only 1.3 p.p.m.

Tracing historical developments, Mr. Kingsbury told of so-called "filter dams" which were used by the Boston water supply at Peagan Brook in the period 1860-70. These "filters" were rock-base dams with a core of sand through which the water was strained when it passed to the reservoir. At the Ludlow dam in 1875 wood boxes filled with excelsior were used as water strainers.

Construction procedure in erecting a butt-welded steel stanpipe was described by William J. Lumbert, water department superintendent, Scituate, Mass. He stressed the need of protect-

(*Continued on adv. page 21*)

BOOK NOTES AND REVIEWS

The month's additions to the engineer's reading and reference list

Housing Progress

HOUSING YEAR BOOK. 1938—By National Association of Housing Officials. Chicago, 315 pp. Price $3.

A product of many authors, the fourth annual Housing Yearbook put out by the National Association of Housing Officials under Coleman Woodbury, director, gives one a complete summary of aims, achievements, personnel and practices in public housing. Activities of non-official agencies and individuals are reflected for the first time. Other material includes a directory of housing agencies, a bibliography of housing literature and for the first time an index.

A Guide to Estimating

ESTIMATES AND COSTS OF CONSTRUCTION — By Frank Whitworth Stubbs, Jr. 234 pp. Published by John Wiley & Sons, Inc., New York and Chapman & Hall, Ltd., London. Price $3.

A veteran estimator once remarked that "experience is the sole basis for estimating construction costs; without a background of experience no one can prepare a correct estimate notwithstanding all the literature published on the subject." Possibly this is true, but unfortunately not everyone who faces the task of preparing cost estimates has this background. It is for this large group of engineers and contractors, and not the experienced estimator, that Prof. Stubbs has written his book on estimating. In contrast to most books on the subject, it is confined to fundamental principles of construction costs, largely ignoring such details as man-hours of production and explicit cost of every item.

Except for an appendix that presents a detailed estimate of a building, the author sticks to the broad picture of costs, repeatedly calling attention to the basic factors comprising the total cost of every construction project.

The book opens with a digest of the U. S. Construction Census to show the magnitude of construction operations and a breakdown of principal cost items. A few subsequent chapters deal with various types of structures, but the bulk of the work is devoted to overhead and intangible items, equipment and plant, bonds, insurance and financing. From beginning to end the reader is constantly reminded of the items to be considered in preparing a cost estimate. The actual cost is rarely given, but after all, the means of determining these costs are more important than the detail figures.

Structures

STRUCTURAL DESIGN—By Carlton T. Bishop, 254 pp. Published by John Wiley & Sons, New York, and Chapman & Hall, London. Price $3.50.

ELEMENTS OF STRUCTURAL ENGINEERING—By Edward S. Sheiry. 475 pp. Published by the International Textbook Co., Scranton, Pa. Price $4.

In reviewing textbooks on such a subject as structural engineering, the reader probably is best served by merely describing the scope and treatment which each author has selected for good and sufficient reasons. Professor Bishop, for example, in preparing his book had the structural engineering student and his need for fundamental knowledge in mind. His approach, based on many years of teaching the subject, is to apply the fundamental principles of design first to detached individual members without regard to their relation to other members in the structure. This permits classroom design of many similar problems before the student is called upon to apply the fundamentals to the design of more complete structures where the interdependence of the different members must be taken into account. The book places considerable emphasis on the design of plate girders, and in the end the student is introduced to the design procedures necessary for bridges, multi-story buildings and industrial buildings.

Professor Sheiry's book is planned as a textbook for students who are not specializing in structural engineering but at the same time there is a stated attempt made to give practicing engineers and those planning for state license examinations a brief review of the fundamentals of new developments in the field. Also, extracts from the latest building codes and the necessary tables and charts are included to make the book a complete unit for self-study.

Data on Dams

DAMS AND CONTROL WORKS — Prepared by the U. S. Bureau of Reclamation. 261 pp. For sale by the Superintendent of Documents, Washington, D. C. Price $1.

Since 1929 when the Bureau of Reclamation first published its booklet "Dams and Control Works," its dam design and construction operations have expanded phenomally. Whereas some $10,000,000 was spent annually during the early period, the yearly bill has been six times that much since 1933. Boulder, Grand Coulee, Bartlett and Imperial belong to this late era, and the new knowledge that they engendered is presented in this new edition and is a reason for its publication.

The present volume contains about 100 more pages than its predecessor and is much more pretentious. An added feature is a section of some 50 pages devoted to laboratory testing and design technique. Articles are included on such special topics as high pressure reservoir outlets and temperature control in mass concrete. The detailed description of 21 dams give a good cross-section view of the problems encountered on all of the 159 dams of the Bureau.

Properties of Timber

TIMBER, ITS STRUCTURE AND PROPERTIES—By H. E. Desch. 169 pp. Published by MacMillan and Co., London, and The MacMillan Co., New York. Price $4.50.

Results of British research into the properties of timber are summarized briefly in this small book, but the fact that it is centered around British practice does not detract from the value of the basic data concerning the properties of wood which it contains. Considerable space is devoted to hardwood and softwood tissues, including fine reproductions of micrographs. A valuable feature is a concise explanation of each term used, also a list of botanical equivalents

of the common or trade names used in the text. Were it not for the price, which according to current practice is set in dollars at practically twice the British equivalent, this book might find wide use in this country.

How To Clean Streets

STREET CLEANING PRACTICE—By the Committee on Street Cleaning. 407 pp. Published by the American Public Works Association, Chicago.

For one of the most important and least understood practices of municipal housekeeping we now have a first-class guide and handbook. Until the American Public Works Association undertook to assemble information on the subject, street cleaning was one of those mysterious municipal activities which somehow existed, but about which no one had much to say.

Bringing together and interpreting the data on methods, experience and operating costs from more than one hundred cities, the association has produced a valuable reference book on modern practices. This is no academic treatise, but a practical presentation of how to clean city streets and keep them clean.

Opening with a discussion on local conditions affecting street cleaning, the book treats of methods and equipment, planning operations, special litter problems, catch basin and inlet cleaning, snow removal, organization, personnel, records and budget. An appendix contains a list of typical street cleaning ordinances, a tabulation of practice and a bibliography.

Members of the committee which compiled the information were: John S. Flockhart, chairman, Newark; Harold D. Bradley, Toronto; William J. Galligan, Chicago; Joseph E. Gill, Philadelphia; Alfred E. Rocke, Albany; William B. Shafer, Pittsburgh; and William Albert Xanten, Washington, D. C.

MISCELLANEOUS NOTES ON BOOKLETS AND REPRINTS

A ROAD MAP of hydraulic engineering in Iowa has been prepared for those who might inspect the structures if they were aware of their nearness to the route being traveled. On the map are shown cities, roads, rivers and lakes, watershed boundaries, road distances and major points of hydraulic interest. The map accompanies Bulletin 15 of University of Iowa Engineering Studies which gives a brief description of each project including the Mississippi River locks and dams and the university's hydraulic laboratory.

PUBLIC WATER SUPPLIES IN GEORGIA—a highly interesting nontechnical pamphlet written for the general public—is being distributed by State Health Department. Address W. H. Weir, Atlanta, Ga.

FEATURES OF THE ILLINOIS WATERWAY are described in a 13-p. planograph pamphlet issued by the Chicago U. S. Engineers District Office. A general description of the project, a map, the locks and dams in the fully canalized waterway to 9-ft. depth, a page on traffic and statement that the project will be completed by the end of the year are included.

A MANUAL OF TESTS listing equipment used and tests made in the Bureau of Standards, Department of Public Works, city of Los Angeles, has just been issued by that city. Although primarily for the city's own needs, the bureau makes tests for other public bodies relative to physical, chemical and biological properties in the fields of sanitary and structural engineering.

NEW PUBLICATIONS

DESIGN OF WEIRS ON PERMEABLE FOUNDATIONS—By A. N. Khosla, N. K. Bose, and E. McKenzie Taylor. 178 pp. Published by the Central Board of Irrigation, Simla, India.

THE PROBLEMS OF A CHANGING POPULATION—Report of the Committee on Population Problems to the National Resources Committee. May, 1938. 306 pp. For sale by the Superintendent of Documents, Washington, D. C. Price 75c. (paper cover).

APPLIED MECHANICS—By Harvey F. Girvin. 336 pp. Published by the International Textbook Co., Scranton, Pa. Price $3.

AIR CONDITIONING—By Charles A. Fuller. 577 pp. Published by the Norman W. Henley Publishing Co., New York. Price $4.00.

ELEMENTS OF WATER SUPPLY ENGINEERING — Second Edition — By Earle L. Waterman. 329 pp. Published by John Wiley & Sons, Inc., New York and Chapman & Hall, Ltd., London. Price $3.50.

STRUCTURAL DESIGN—By Hale Sutherland and Harry Lake Bowman. 402 pp. Published by John Wiley & Sons, Inc., New York and Chapman & Hall, Ltd., London. Price $4.50.

HOW TO BE A RESPONSIBLE CITIZEN—By Roy V. Wright and Eliza G. Wright. 203 pp. Published by the Association Press, 347 Madison Avenue, New York. Price $2.00.

DESIGN OF STEEL BUILDINGS—Second Edition—By Harold Dana Hauf. 232 pp. Published by John Wiley & Sons, Inc., New York and Chapman & Hall, Ltd., London. Price $2.75.

HISTORY OF AMERICAN CITY GOVERNMENT—The Colonial Period By Ernest S. Griffith. 464 pp. Published by the Oxford University Press, New York. Price $3.75.

ENGLISH FOR STUDENTS IN APPLIED SCIENCES—By S. A. Harbarger, W. R. Dumble, W. R. Hildreth and Bert Emsley. 260 pp. Published by McGraw-Hill Book Co., New York and London. Price $2.

THE BIG FOUR—The Story of Huntington, Stanford, Hopkins and Crocker, and the Building of the Central Pacific—By Oscar Lewis. 418 pp. Published by Alfred A. Knopf, New York. Price $4.50.

ADVANCED MATHEMATICS FOR ENGINEERS—By H. W. Reddick and F. H. Miller. 473 pp. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, London. Price $4.

DRAINAGE BASIN STUDY OF PENNSYLVANIA—In Three Parts—141, 153 and 158 pp., respectively. Prepared and Published by the Pennsylvania State Planning Board, 928 North Third St., Harrisburg, Pa.

CONCRETE PIPE IN AMERICAN SEWERAGE PRACTICE. Prepared and edited by M. W. Loving. 170 pp. Published by the American Concrete Pipe Association, 33 West Grand Avenue, Chicago.

FLUID MECHANICS FOR HYDRAULIC ENGINEERS—By Hunter Rouse. 422 pp. An Engineering Societies Monograph. Published by McGraw-Hill Book Co., New York and London. Price $5.

AMERICAN ROAD BUILDERS' ASSOCIATION: Convention Proceedings, 1938, 911 pp.; 1938 Convention Program and Directory of Exhibits, 175 pp. Published by the American Road Builders' Association, National Press Building, Washington, D. C. Price $10.

FROM FIELD AND OFFICE

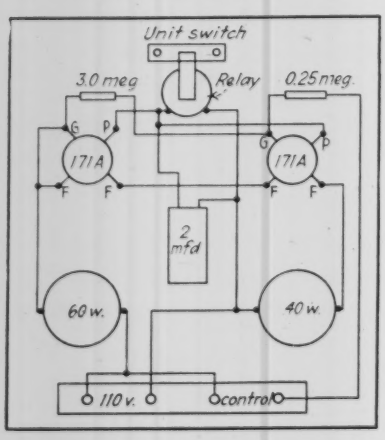
Working problems and time-saving methods . . . Edited by Charles S. Hill

Relay for Temperature-Control Thermometers

M. E. PRIOR
Dewey and Almy Chemical Company, Cambridge, Mass.

In using the Dekotensky thermometers for controlling the temperatures in our water bath and other critical sections of the laboratory it has been our experience that the contact point corroded very easily when operated directly in the circuit of the equipment to be controlled. This corrosion, due to arcing when the contact was broken, caused a reduction in sensitivity thus defeating the purpose of the instrument. In order to insure a reliable control of our temperature without frequent upsets due to corrosion, we made use of the current control available in an ordinary radio vacuum tube and incorporated it with a relay. The contacts of the relay will handle any current requirement of heating units or fans with no possibility of corroding the fine mercury contact point of the control thermometer. This gives us a constant accurate control requiring attention only to replace bulbs. The bulbs, incidentally, have an extremely long life because they are all in series.

The accompanying sketch gives the wiring diagram and layout. The list of parts necessary is as follows: Two 115 v. porcelain light sockets; two radio tube sockets for 171-A tubes; one relay—Leach 60 v. 2700 ohm coil; one 2 mfd. condensor; one 0.25 megohm resistor (1 watt); one 3.0 megohm resistor (1 watt); four binding posts; one hard rubber mounting strip 1x5 in. for posts; two 171-A type radio tube; one 25-watt light bulb; one 40-watt bulb, and one 6x9 in. wood board for mounting.



Wiring diagram of relay for use with temperature-control thermometers.

The total cost of this unit should be about $9 including $4 for the relay.

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Bending Trussed Bars

WILLIAM SELL
Lansing, Mich.

The accompanying nomographic chart will be found useful by reinforced concrete detailers when laying out bent bars for slabs and beams. Where half the bottom steel is bent up, and the load is uniform, the bottom bending point is about 0.2L from the support. At a simply supported end, one third of the steel can be bent up similarly. The usual slope of the bent up portion is 45 deg.

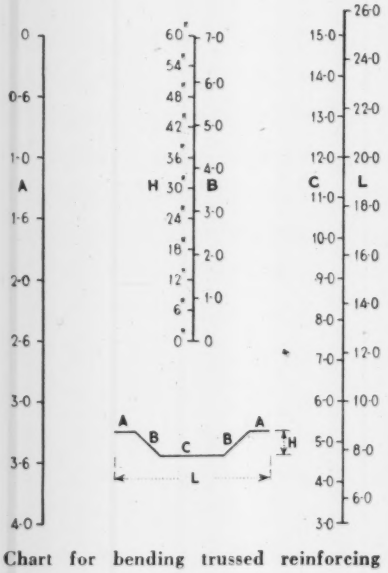

Chart for bending trussed reinforcing bars.

These recommendations are embodied in the chart: *L* is the clear span, *H* is the center-to-center height of the trussed bar, i.e. the vertical thickness of the beam or slab less allowances for fireproofing. A straight edge (a line scribed on a transparent triangle is convenient) is placed across the diagram cutting the *H* and *L* scales at the proper values; *A*, *B*, and *C* are read off directly beneath the straight edge. For example, if the span is 15 ft. 10 in. and *H* is 20 in., we find *A* is 1 ft. 6 in., *B* is 2 ft. 4 in. and *C* is 9 ft. 6 in.

To the value of *A*, in either side, must be added the width of column, extension into the next beam, or hook, as required.

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Deflection Angles

A simple method of computing deflection angles in laying out curves, submitted by James J. Rettinger, was published in this section in the issue of June 19, 1938, p. 849. We now find that the same method was outlined in a somewhat longer article submitted to us by James L. Davis of East Orange, N. J., in May, 1937. Because of the crowded condition of our publishing schedule existing at that time the article was returned to Mr. Davis.

Credit for having first proposed the method to us, therefore, should go to James L. Davis. Mr. Davis states that he derived the formula in 1931 and has used it since that time.

—The Editors

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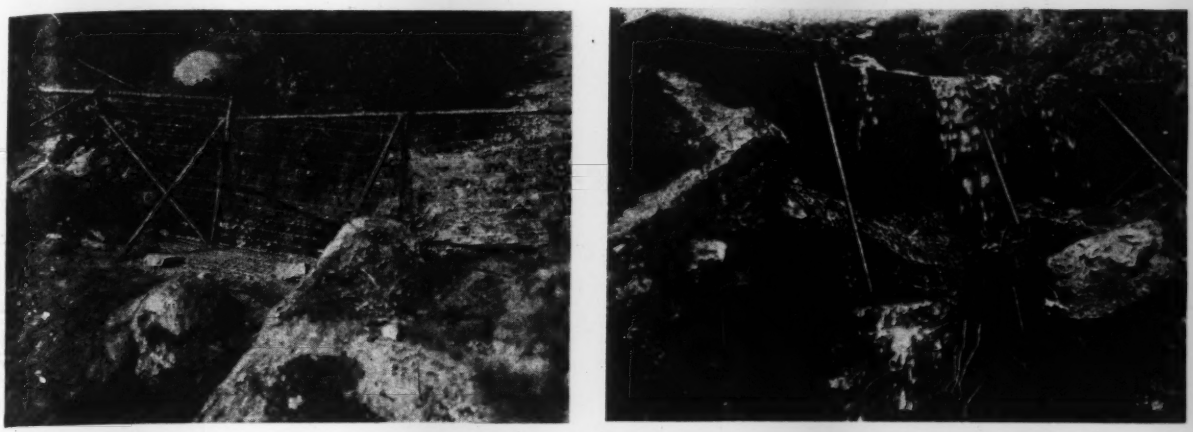
Simple Sand Moisture Test

STERLING S. GREEN
Junior Engineer, Bureau of Water Works and Supply, Los Angeles, Cal.

In revising and simplifying the standard specification for the purchase of concrete aggregates by the Los Angeles Department of Water and Power, attention was directed to a provision in the old specification that the sand should be rammed in a metal container and to be acceptable, no water could show on the surface of the compacted sand. A simple calculation and a laboratory test indicated that the allowable amount of water in sand of 2.65 s.g. and having 33 per cent voids was 19 per cent based on dry weight of sand under this provision. In other words, in each ton of sand furnished, it is possible to have as little as 1,680 lb.



CAMERA MEMORANDA

These before- and after-test views of a check dam in a small wash near Los Angeles, Calif., furnish an interesting lesson on behavior. The dam was built of iron pipe and heavy fence wire as shown at the left, and attention is directed to the fence-wire apron laid on the ground below the dam to reduce scour. At the right is a view of the dam after a torrent had descended the gulley; the dam is packed full of retained debris over the top of which flowing water has a clear vertical fall to the apron below with the result shown.

of dry material. General practice in the Los Angeles area is to consider 1 gal. of water per cu.ft. of rodded material to be a maximum amount of moisture allowable in wet sand. This would constitute 7.6 per cent surface moisture or a total moisture of 8.2 per cent allowing 0.6 per cent for absorption. It was desired to specify a simple test to determine whether the moisture of the sand being delivered was reasonably close to this figure. The following test was devised which has the advantage of simplicity and which requires no special equipment. A vertical-wall, flat-bottom container is filled one-fifth full of water. A sample of the sand to be tested is poured and rodded into the container until the container is filled. If the water level comes to the brim of the container before the sand level does, the sand has over 7.5 per cent surface moisture or a total of 8.1 per cent including absorbed moisture. This test was demonstrated to representatives of several local aggregate producers and met quick approval.

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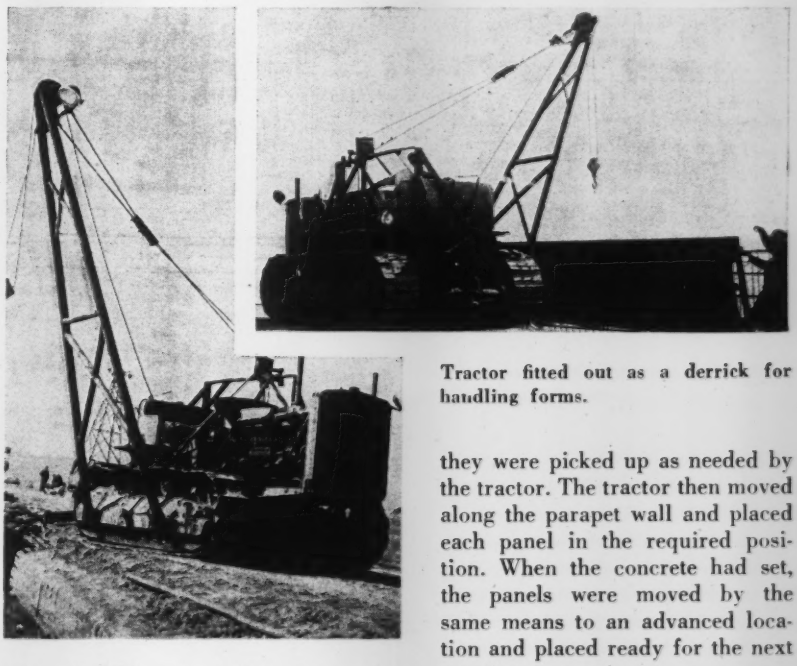
Tractor Becomes Mobile Derrick

Time was saved in constructing Cajalco Dam of the Metropolitan Water District by a simple device attached to a tractor for use in placing the heavy form panels for the parapet wall. The attachment consisted chiefly of a welded, tubular A-frame attached to lugs welded to the tractor frame. A cable from the top of the frame to a well-braced anchorage on the tractor was made adjustable so that the angle of overhang could be changed. A cable from a gypsy head on the tractor to a sheave at the top of the A-frame operated the hook with which the form panels were lifted.



Tractor fitted out as a derrick for handling forms.

Form panels were assembled on the fill at a convenient point whence they were picked up as needed by the tractor. The tractor then moved along the parapet wall and placed each panel in the required position. When the concrete had set, the panels were moved by the same means to an advanced location and placed ready for the next pouring.

The tractor attachment was designed and built by the staff of the Metropolitan Water District, F. E. Weymouth, general manager and chief engineer.

$3 to $5

paid on acceptance for items suitable for the pages of From Field and Office

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

UNDERPASS, DETROIT

OWNER: Wayne County Road Commission; Leroy C. Smith, engineer.

PROJECT: General excavation, grading, drainage, etc., for grade separation at the intersection of Outer Drive (Lantz Avenue) and the Grand Trunk Western Railroad. Total length is 925 ft. Pavement width is 60 ft. The roadway is flanked by 7½-ft. parking strips, 6-ft. sidewalks and an embankment 21½ ft. wide. Stipulated contract time is 140 days. Truck transportation is available. Excavation is to be in layers, and under a trestle.

BIDS: Thirteen bids were received Sept. 16, 1938, ranging from the contract low of $33,353 to $49,104. Labor rates are as follows: skilled, $1.50 per hr. down; semi-skilled, $1.00 per hr.; common, 75c. per hr.

LOW BIDDERS:

1. Charles J. Rogers, Detroit (contract) $33,353
2. Frank J. Knight Co., Detroit 33,650
3. G. Vella Co., Detroit 35,561

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Gen. excav.	27,600 c. y.	$0.63	$0.57	$0.45
2. Conc. retaining wall	97 c. y.	14.00	24.50	25.00
3. Reinf. steel	4,700 lb.	.04	.06	.06
4. Pipe handrail	177 l. f.	2.50	7.80	3.00
5. Conc. stairways	8 c. y.	25.00	25.00	35.00
6. 24-in. reinf. conc. sewer pipe	780 l. f.	4.40	3.50	7.00
7. 2ft. 8 in. x 4 ft. two-ring brick egg-shaped tunnel sewer	66 l. f.	13.00	25.00	16.00
8. 18-in. R. C. sewer pipe	152 l. f.	3.10	2.50	2.50
9. 12-in. R. C. sewer pipe	1,200 l. f.	1.60	1.50	1.45
10. 8-in Vit. tile sewer	410 l. f.	.70	.75	.95
11. 6 in. Vit. tile drains	1,450 l. f.	.35	.30	.58
12. 6 in. Vit. tile slope drains, 3 ft. or less	1,000 l. f.	.45	.35	.53
13. 6 in. Vit. tile slope drains, 3 ft. to 6 ft.	500 l. f.	.85	.35	.60
14. 6 in. Vit. tile slope drains, 6 ft. to 9 ft.	300 l. f.	1.00	.50	.80
15. 6 in. Vit. tile slope drains, 9 ft. to 12 ft	220 l. f	1.00	.60	1.20
16. Sewer manholes	10 ea.	97.50	75.00	100.00
17. Sewer catchbasins	20 ea.	48.00	50.00	40.00
18. Conc. encasement of exist. sewer	4 c. y.	12.00	15.00	35.00
19. 6-in. Vit. tile over bridge footings and for wall connections.	207 l. f.	.25	.30	1.50
20. Underground lighting service from PLC cable pole	L. S.	1,200.00	1,310.00	1,400.00
21. Lowering of existing 6-in. and 8-in. water main in order to provide 5 ft. of cover	950 l. f.	1.75	2.50	5.00

ROLLED EARTH DAM, OHIO

OWNER: Board of Control, City of Akron; W. R. LaDue, engineer.

PROJECT: Construction of a rolled earth storage reservoir dam, 2,200 ft. long and 34 ft. high, with an around-the-end spillway. Dam is scheduled to be completed before Feb. 1, 1939, and rail transportation facilities are available.

BIDS: Five bidders turned in alternate bids, one for concrete paving and one for stone paving, Aug. 3, 1938, ranging from $275,871 to $342,373. Minimum wage rates are as follows: skilled, $1.00 per hr.; semi-skilled, 65c. per hr.; common, 65c. per hr. Figures given here are for concrete slope paving.

LOW BIDDERS:

1. Bates & Rogers Construction Corp., Chicago.. $275,871
2. Shullo Construction Co., Akron 290,401
3. W. L. Johnston Construction Co., Hicksville, O. 297,304

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Stream flow control, unwatering	L. S.	$4,200.00	$24,000.00	$11,400.00
2. Clear., grub	L. S.	475.00	2,000.00	1,000.00
3. Common excav	36,000 c. y.	0.44	0.30	0.50
4. Borrow pit excav	135,000 c. y.	0.275	0.25	0.36
5. Compacted embank. backfill	115,000 c. y.	0.12	0.05	0.18
6. Rockfill toe drain	3,800 c. y.	4.50	5.50	3.00
7. Screened gravel, sand	6,200 c. y.	3.55	4.00	3.00
8. Stone paving	2,100 s. y.	4.00	3.50	4.00
9. Gutter pav	260 s. y.	5.30	3.00	4.00
10. 4-in. V.P. spillway subdrains	1,250 l. f.	0.30	0.35	0.35
11. 10-in. V.P.spillway subdrains	450 l. f.	0.90	0.50	0.70
12. 6-in. V.P. drain	40 l. f.	0.45	0.35	0.80
13. 8-in. V.P. drain	100 l. f.	0.60	0.40	0.80
14. Loam surfacing	10,000 c. y.	0.60	0.35	0.30
15. Seeding	10 acre	155.00	100.00	200.00
16. Steel sheetpiling	60 ton	92.50	80.00	90.00
17. Cement	10,000 bbl.	2.30	2.00	2.30
18. Conc. masonry	3,900 c. y.	11.85	14.00	12.00
19. Conc. slope paving	10,700 s. y.	2.25	2.50	2.50
20. Reinf	340,000 lb.	.047	.044	.044
21. Copper water stops	3,300 lb.	0.45	0.65	0.80
22. Precast conc. pipe	150 l. f.	44.20	37.00	38.00
23. Intake gate house superstructure	L. S.	3,000.00	4,000.00	3,600.00
24. C.I. pipe, fittings	L. S.	6,000.00	6,000.00	5,500.00
25. Valves	L. S.	5,700.00	4,000.00	4,400.00
26. Venturi meter tube	L. S.	3,400.00	3,500.00	3,400.00
27. Water level recorder	L. S.	175.00	250.00	250.00
28. Misc. metal work, stop planks	L. S.	2,475.00	3,000.00	2,000.00
29. Misc. C.I. work	L. S.	2,125.00	2,500.00	3,600.00
30. Field office	L. S.	1,325.00	3,000.00	1,600.00

WATERWORKS IMPROVEMENT TUCSON, ARIZ.

OWNER: City Water Department, Tucson, Ariz.; Phil J. Martin, Jr., water superintendent.

PROJECT: Laying 21,000 ft. of water main, divided as follows: 7,500 ft. of 4-in. main; 13,500 ft. of 6-in. main. Work is located in five separate paving districts, and is to be conducted ahead of PWA paving projects. Stipulated contract time is 100 days. Transportation facilities by rail and highway are available. Minimum wages are as follows: skilled, $1.00 per hr.; semi-skilled, $0.75 per hr.; common, $0.625 per hr.

BIDS: Five bids were received Sept. 6, 1938, ranging from the contract low of $40,751 to $59,950. Each bidder was asked to submit bids for both cast iron pipe and asbestos cement pipe.

LOW BIDDERS:

1. Williams & Van Valkenburgh Construction Company, Los Angeles, Calif. (contract, cast iron pipe) $40,751
2. M. M. Sundt Construction Co., Tucson (asbestos cement pipe) 41,881
3. Arizona Concrete Company, Phoenix (cast iron pipe) 45,157

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Excav., backfill	5,500 c. y.	$1.18	$1.50	$1.39
2. Pav. cuts, replacement	100 s. y.	6.00	1.50	2.26
3. 2-in. C. I. pipe	100 l. f.	.57	.59	.50
4. 4-in. C. I. pipe	7,500 l. f.	.69	.67	.72
5. 4-in. asbestos cem. pipe	7,500 l. f.	.80	.55	.72
6. 6-in. C. I. pipe	13,500 l. f.	.95	1.02	1.02
7. 6-in. asbestos cem. pipe	13,500 l.f.	1.05	.87	1.02
8. 6-in. C. I. pipe (f. l. ext.)	650 l. f.	1.00	1.20	1.02
9. 8-in. C. I. pipe	75 l. f.	1.30	1.47	1.50

(Contract Unit Prices continued on second following page)